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NEUE *IMPATIENS*-ARTEN AUS ANGOLA UND BEMERKUNGEN ZU EINIGEN IN ANGOLA VORKOMMENDEN *IMPATIENS*-ARTEN

von

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DEN Beschreibungen der neuen Arten wurde nicht nur das als Typus bezeichnete Exemplar zugrunde gelegt, sondern jeweils das ganze aufgeführte Material, um somit die Merkmale der Arten, soweit dies bereits möglich ist, anzugeben. So ist es oft notwendig, um z. B. die Blütenverhältnisse einigermassen gut zu erfassen, geeignetes Blütenmaterial verschiedener Nummern zur Beschreibung zu benutzen. Die häufige Geringblütigkeit der Exemplare und der oft sehr schlechte Zustand der Blüten von *Impatiens* im Herbar machen dies Verfahren notwendig, wenn anders eine Beschreibung nicht sinnlos oder gar nur eine formale Erfüllung der Vorschriften des Code der Botanischen Nomenklatur werden soll. Um dies Verfahren zum Ausdruck zu bringen, wurde versucht, falls es notwendig erschien, jene Merkmale, die an dem Typusmaterial nicht sichtbar sind, jedoch an dem übrigen genannten Material erkannt werden konnten, dadurch in der Beschreibung zu kennzeichnen, dass sie in Klammern gesetzt wurden. Es ist dies der Versuch eines Weges, der vielleicht aus dem Dilemma führt, das sich aus strenggenommenen Konsequenzen der Typenmethode ergibt, wie sie der Code der Botanischen Nomenklatur vorschreibt.

Es sei noch erwähnt, dass die «Analysen» der Blüten vornehmlich mittels eines Durchleuchtungsverfahrens erfolgten und nicht durch die gewöhnlich übliche Methode des Aufweichens der Blüten in einem flüssigen Medium. Dieses Verfahren, von mir seit einiger Zeit geübt, hat vor allem den Vorteil, dass das meist kostbare Blütenmaterial möglichst unverändert erhalten bleibt. Nur selten findet man gut gepresste Blüten an den *Impatiens*-Exemplaren, und nur hin und wieder liegen gut und

zur Untersuchung vorteilhaft gepresste Blüten bzw. Blütenteile in Kapseln den Nummern bei.

Der Freundlichkeit der Herren A. W. Exell und F. A. Mendonça verdanke ich es, dass mir das *Impatiens*-Material von Angola zur Verfügung gestellt wurde. Nicht nur besondere Umstände, sondern vor allem die ausserordentlichen systematischen und technischen Schwierigkeiten, die sich immer wieder bei dem steten Bemühen um eine möglichst saubere Durcharbeit des *Imptiens*-Herbarmaterials ergeben, haben leider die Fertigstellung der Untersuchungen zu meinem eigenen Bedauern sehr verzögert.

Ausser der Mitteilung von drei Arten, die nach meiner Ansicht durchaus neue Taxa darstellen, halte ich es im Hinblick auf die Aufführung der *Impatiens*-Arten im Conspectus Florae Angolensis für notwendig, erklärende Bemerkungen für einige weitere in Angola vorkommende Arten zu geben. Hierbei möchte ich auch meine Auffassung über diese Arten mitteilen, die ich insbesondere durch das Studium des angolensischen Materials gewonnen habe.

Impatiens Exellii G. M. Schulze n. spec. (Tab. I)

Herba locos humidos habitans, caule glabro parte inferiore ad nodos radicans, interdum praesertim parte superiore ad nodos tentaculis minutissimis instructo. *Folia* opposita breviter sed manifeste petiolata; lamina magnitudine (formaque) varians (lanceata), usque lanceato-ovata e basi rotundata vel leviter subcordata apice acuta usque leviter acuminata, margine ± remote adpresso-serrata serraturis mucronulatis in angulis inter serraturas apiculis glanduliformibus, utrinque glabris (vel interdum praesertim in innovationibus pilis obsita), subtus pallida in sicco nervis — subtus praesertim — inconspicuis, usque ad 2,5 cm longa (vel longiora), usque ad 1,5 cm lata. *Inflorescentiae* solitariae in axillis foliorum supremorum (superiorumque), pauciflorae, bracteis minutis subclavaeformibus basi tentaculiferis, circ. 0,15 cm longis; pedicelli usque ad 0,9 cm longi. *Sepala* integerrima, non tentaculifera, subelliptica apice tumida (usque ad 0,2 cm longa, circ. 0,1 cm lata). *Labellum* oblique infundibuliforme, circ. 0,2 cm altum, ore circ. 0,4 cm latum, ± subito

in calcar ± leviter curvatum contractum, omnino (i. e. cum altitudine labelli) usque ad 1,2 cm longum (vel brevius). *Vexillum* circ. 0,35 cm altum; alae bilobae omnino usque ad 0,9 cm longae (vel breviores) appendiculatae, appendiculae filiformes in calcar descendentes, usque ad 0,7 cm longae, lobi laterales angustilingulati circ. 0,1 cm lati, lobi anteriores lateraliter dilatati margine laterali-exteriore retusi, usque ad 0,3 cm lati.

LUNDA: River Chiumbe, Dala, c. 1.200 m. Growing in water and rooting at the nodes. Flowers white with pink spur. — 25.4.1937, *Exell & Mendonça* 1069 (BM, typus; COI); Dala. Proximum flumen Chiumbe. 1.150 m. Rhizomatous base; corolla flesh coloured, in Emersiherbosa on river bank. — April 1937, *Gossweiler* 11178 (BM; COI); Lugares sombrios da margem do rio Chiumbe nas cataractas de Dala. — 24.9.1927, *Carrisso & Mendonça* 566 (BM; LIS JC); River Cassai, c. 1190 m. In «tengas» (marshes). Humidiherbosa, — 28.4.1937, *Exell & Mendonça* 1351 (BM; COI; LIS JC).

MOXICO: Teixeira de Sousa. Proximum flumen: Lucinda-Luao. 1100 m. In humidiherbosa. — 3.7.1940, *Gossweiler* 12243 (BM).

Zu dieser *I. Briartii* De Wild. nahe verwandten Art vgl. die unten folgenden Bemerkungen zu *I. Briartii* De Wild.

***Impatiens Mendoncae* G. M. Schulze n. spec.** (Tab. II)

Herba (perennis, parte inferiore ad nodos radicans), caule sparse vel sursum ± dense (breviter vel) brevissime piloso basin versus glabrescente. *Folia* alterna breviter petiolata (usque subsessilia); lamina late lanceolata basin versus ± (distincte) angustata vel subcuneata vel subacuta, apicem versus ± sensim acuminata, margine remote mucronato-serrata, serraturis paulum usque vix prominentibus, subtus pallida, in sicco nervis lateralibus utrinque vel subtus praesertim vix conspicuis (vel inconspicuis), supra (glabra vel) pilis brevissimis vix conspicuis ± dense obsita (vel glabrescens), subtus ± disperse pilosa (vel glabrescens), usque ad circ. 10,0 cm longa vel brevior, usque ad circ. 4 cm lata vel angustior; petioli ± dense pilis obsiti

(vel glabrescentes), (plerumque) tentaculis crassiusculis obsiti, usque ad circ. 1,5 cm longi vel breviores. *Flores* solitarii in axillis foliorum superiorum; pedicelli (glabri vel interdum) ± dense pilis obsiti (vel glabrescentes), usque ad circ. 5,0 (6,0) cm longi vel breviores; sepala lanceolato-ovata apice acuminata vel subcuspidata (glabra vel interdum) ± dense pilosa usque ad circ. 0,4 (0,5) cm longa, circ. 0,25 cm lata. *Labellum* oblique infundibuliforme (glabrum vel interdum) ± disperse pilosum, usque ad circ. 0,8 cm altum, ore usque ad circ. 1,1 cm latum, ± subito in calcar gracile longumque contractum initio curvatum deinde subrectum vel ± curvatum apicem versus sensim attenuatum omnino (i. e. cum altitudine labelli) usque ad circ. 6,0 (6,7) cm longum vel brevius contractum. *Vexillum* subgaleiforme suborbiculatum (?) usque ad circ. 1,3 cm altum; alae bilobae omnino usque ad circ. 2,3 cm longae, lobi laterales subobovati margine exteriore leviter retusi mucronulati usque ad circ. 1,5 cm longi, usque ad circ. 1,3 cm lati vel angustiores (lobi anteriores subobovata margine interiore frontem versus retusi mucronulati, usque ad circ. 1,7 cm longi, usque ad circ. 1,5 cm lati).

LUNDA: River Chinege, 1000-1100 m. Perennial herb. Flowers mauve-pink; spur white. Gallery-forest. — 20.4.1937, *Exell & Mendonça* 784 (BM, typus; COI; LIS JC); Vila Henrique de Carvalho. — *Young* 1194 (BM); Vila Henrique de Carvalho. Growing by margin of shallow stream. — 29.10.1932, *Young* 1225 (BM); Near Vila Henrique de Carvalho, c. 1100 m. Herb rooting at nodes; flowers rose-purple with white spur. Gallery forest. — 14.4.1937, *Exell & Mendonça* 554 (BM; COI; LIS JC); Near Vila Henrique de Carvalho, 1100 m. Gallery-forest. — 14.4.1937, *Exell & Mendonça* 565 (BM; COI); River Luachimo, near Vila Henrique de Carvalho, ca. 1000 m. Flowers purple; spur white. Gallery-forest. — 17.4.1937, *Exell & Mendonça* 713 (BM; COI); River Chicapa, Vila Henrique de Carvalho. — 6.8.1932, *Young* 408 (BM); Muriege, ca. 1000 m. Flowers pale mauve. Shady places in « tengas » (marshes). — 19.4.1937, *Exell & Mendonça* 854 (BM; COI).

MOXICO: Teixeira de Sousa. Proximum flumen Luao. 1100 m. Persistent herb in Humidiherbosa of the edaphic

Lauriifruticeta. — 5.7.1940, *Gossweiler* 12231 (BM); Teixeira de Sousa. Proximum flumen Lucinda-Luao. Perennial in humidiherbosa. Corolla pale red. — 3.7.1940, *Gossweiler* 12247 (BM).

Diese Art könnte auf den ersten Blick mit *I. Irvingii* Hook. f. verwechselt werden, insbesondere dann, wenn die Blüten nicht voll entwickelt sind. Sie steht *I. Irvingii* sehr nahe, fällt jedoch vegetativ bereits durch ihre Blätter auf, die durchschnittlich mehr zur breit-lanzettlichen Form neigen, wobei die grösste Breite der Spreite in der Mitte liegt, und ferner dadurch, dass (jedenfalls an Herbarexemplaren) die Nerven oberseits, vor allem aber unterseits kaum oder überhaupt nicht sichtbar sind; die Blüte in vollster Entwicklung zeigt einen auffallend langen Sporn.

***Impatiens Gossweileri* G. M. Schulze n. spec.** (Tab. III)

Herba usque ad 20 cm alta. Caulis parte inferiore ad nodos radicans, sursum ± dense pilis brevibus obsitus. *Folia* petiolata alterna; lamina lanceato-ovata, subtus pallida, utrinque interdum ad nervos pilis obsita, margine serrata, in angulis inter serraturas minutissime mucronata, magnitudine varians, usque ad circ. 4 cm longa vel brevior, usque ad circ. 3 cm lata vel angustior; petioli ± pilis obsiti, usque ad circ. 3 cm longi vel breviores. *Inflorescentiae* in axillis foliorum supremorum 1-2-florae; pedunculi basin versus pilis paucis brevissimis interdum obsiti, usque ad 3 cm longi; bracteae 2, oppositae subellipiticae 0,4-0,5 cm longae, circ. 0,25 (?) cm latae, pedicellus usque ad circ. 0,8 cm longus. *Sepala* lanceolata, circ. 0,8 cm longa, circ. 0,35 cm lata. *Labellum* cymbiforme, circ. 0,3 cm altum, ore circ. 1 cm latum, subito in calcar breve apicem versus clavaeformi-inflata, circ. 0,4 cm (omnino, i. e. cum altitudine labelli, 0,7 cm) longum contractum. *Vexillum* subellipticum (?) circ. 0,7 cm altum, circ. 0,4 (?) cm latum, alae bilobae omnino usque ad 2 cm longae (vel breviores), lobi laterales linguilati, circ. 0,5 cm longi, circ. 0,35 cm lati, lobi anteriores dilatati margine interiore ut videtur emarginati, usque ad 0,7 (?) cm lati.

CABINDA: Gregarious succulent herb with whitish terminal fl. Here and there in patches on the rocky humid banks of the

River Nzanza in the Mbulo Hills. — 15.2.1919, *Gossweiler* 7822 (BM; COI; LIS JC; LISU, typus).

Diese relativ kleinblättrige und kleinblütige Art ist mit der grossblättrigen und grossblütigen *I. macroptera* Hook. f. verwandt; beiden liegt offensichtlich der gleiche Blatt- und Blütentyp zugrunde.

1. BEMERKUNGEN ZU *IMPATIENS ASSURGENS* BAKER.

Die Sect. *Kathetophyllon* wurde von WARBURG mit der von ihm beschriebenen *I. sweertioides* aufgestellt; diese Art gründet sich auf Material, das v. MECHOW unter n. 572 c in Angola, Malange, Quifocussa, 1881 gesammelt hatte (vgl. Englers Bot. Jahrb. 22: S. 46, 49, 50. 1895). Später hat dann GILG zwei weitere Arten *(I. Bussei, I. jodotricha)* von Ostafrika als neu beschrieben und zusammen mit *I. katangensis* De Willd., *I. assurgens* Bak. (*I. gratioloides* Gilg) und *I. refracta* Wild. der genannten Sektion zugeordnet (vgl. l. c. 43: 98-99. 1909).

Es konnte bisher kein Zweifel bestehen, dass die genannten Arten — bis auf *I. refracta* De Wild. — sich zumindest untereinander sehr nahe stehen. Es liessen sich auch, solange nur wenig Material vorlag, diese Arten noch gut auseinander halten. Unter den *I. sweertioides* Warb. kennzeichnenden Merkmalen (u. a. die anscheinend eigenartige Behaarung) hatte WARBURG angegeben: «... labello ... in calcar breve apice incurvatum abrupte exeunte...» (l. c. 22: 49. 1895); «... nur die Spitze ist hakenförmig gekrümmt.» (l. c. 50). Diese Charakteristik der Spitze des Spornes benutzte DE WILDEMAN u. a. als unterscheidendes Merkmal für *I. katangensis* gegenüber *I. sweertioides*.

Bei meinen Untersuchungen konnte ich jedoch feststellen, dass WARBURG seiner Beschreibung von *I. sweertioides* eine Blüte zugrunde gelegt hatte, die noch nicht voll entwickelt war. Zwischen Blättern des Typusmaterials verborgen fand sich eine zweite Blüte in offensichtlich fortgeschrittenem Zustand, bei der der Sporn am Ende ohne jegliche hakenförmige Krümmung gerade ausläuft.

Je mehr Material, das dieser Sektion zugehört, mir jedoch im Laufe der letzten Jahre zur Untersuchung zur Verfügung stand, umso schwieriger gestaltete sich immer mehr die Ent-

scheidung, welchen der genannten Arten die betreffenden Exemplare zuzuteilen wären. Bereits 1935 stellte ich *I. katangensioides* De Wild. zu *I. assurgens* Bak. (vgl. Notizbl. Bot. Gart. u. Mus., Berlin-Dahlem, **12**: 740. 1935).

Die Untersuchungen ergaben, dass nicht nur die Art und das Vorkommen der Behaarung, sondern auch die Form und Grösse der Blätter offensichtlich sehr variabel sind. Die Untersuchung der Blüten-soweit dies für *Impatiens*-Blüten mit z. T. besonderen, im Laufe der Zeit hierfür entwickelten Methoden möglich war — zeigten eine weitgehende Übereinstimmung. Gewiss lassen sich auch hier für den, der mit den Schwierigkeiten der Erfassung von *Impatiens*-Blüten an Herbarmaterial nicht vertraut ist, zunächst leichte Verschiedenheiten beobachten; es ist jedoch sehr die Frage, ob diese tatsächlich vorhanden sind oder ob sie durch den Entwicklungszustand oder vor allem durch die Präparation des überaus empfindlichen Materials bestimmt sind. Die beiden letztgenannten Momente sind von grösster Bedeutung für die Beurteilung der Blütenverhältnisse. Ausserdem möchte ich an dieser Stelle darauf hinweisen, dass den Beschreibungen der genannten Arten, mit Ausnahme von *I. assurgens* Bak., besonders in bezug auf die Blüten ein ausserordentlich dürftiges, wenn nicht gar als unzureichend zu bezeichnendes Material zugrunde liegt, sodass nur langjährige Erfahrungen einigermassen ein kritisches Beurteilen ermöglichen.

Meine Vermutung, dass die Art und das Vorkommen der Behaarung sowie die Form und Grösse der Blätter keine die genannten ersten fünf Arten mitkonstituierenden Merkmale darstellen, wurde immer mehr bestärkt, je mehr Material ich erhielt. Besonders wertvoll war mir in dieser Hinsicht auch das Angola-Material, das die gleiche Variabilität wie das Material aus anderen Gebieten Afrikas aufweist. (Gilg hatte bereits 1908 das Material Dr. F. C. Wellman 1906 s. n. Herb. Kew als *Impatiens sweertioides* Warb. var. *glabrescens* Gilg bezeichnet!). Es kommen sogar aus Ostafrika und Angola derartig gleiche Exemplare vor, dass es, falls keine Etiketten vorliegen würden, nicht möglich wäre zu entscheiden, aus welchem Gebiet das betreffende Material stammt. (z. B. *H. G. Faulkner* n. A 375 aus Ganda, Benguela und *Busse* n. 948, Mgaka-Tal, Typus von *I. Bussei* Gilg).

So drängt sich mir immer mehr die Überzeugung auf, dass wir es mit einer einzigen Art zu tun haben: *I. assurgens* Bak. Zu dieser gehören ausser *I. gratioloides* Gilg und *I. katangensioides* De Wild. noch *I. sweertioides* Warb., *I. katangensis* De Wild., *I. Bussei* Gilg und *I. jodotricha* Gilg. Ob *I. jodotricha* Gilg und vor allem *I. katangensis* De Wild. vielleicht doch als besondere Taxa anzusprechen sind, darüber könnte nur Näheres ausgesagt werden, wenn mehr und vor allem besseres Material möglichst von den Originalfundorten her vorliegt. Das Material, auf dem sich diese beiden Arten gründen, ist aussergewöhnlich unzureichend.

Somit haben wir es bei *I. assurgens* Bak. sens. lat. mit einer Art zu tun, bei der die Blätter einen Grundtyp aufweisen, bei der aber die Variabilität in Form und Grösse der Blätter sowie in der Art und in dem Vorkommen der Behaarung zum Wesen der Art gehört, selbst aber wohl keine eigentlichen Taxa innerhalb der Art bestimmt.

(In einer besonderen Veröffentlichung über diese Art werde ich auch auf einige herbariologische Kuriosa hinweisen, die sich aus dem Umstand ergeben haben, dass man die Behaarung als ein die Art charakterisierendes Merkmal in dieser Gruppe ansah).

Die Synonymie wäre demnach folgende:

Impatiens assurgens **Baker** in Kew Bull.: 64. 1895 (ausgegeben im März 1895).
I. sweertioides Warb. in Englers Bot. Jahrb. **22**: 49. 1895 (ausgegeben am 19. Nov. 1895).
I. gratioloides Gilg in l. c. **30**: 350. 1901.
I. katangensis De Wild. in Etudes Fl. Katanga: 82. 1903.
I. Bussei Gilg in Englers Bot. Jahrb. **43**: 98. 1909.
I. jodotricha Gilg l. c.
I. katangensioides De Wild. in Ann. Soc. Brux. **40**, 2: 103. 1921.

2. BEMERKUNGEN ZU *I. BRIARTII* DE WILD. ET TH. DUR.

Diese Art gründet sich auf Material, das im Kongogebiet von Briart (s. n.) gefunden wurde (Lualaba bei Nzilo). Das Material *Dawe* 314, S. Buddu in Uganda, das Gilg auch zu

dieser Art rechnet, habe ich bisher noch nicht gesehen. Das Original-Material von *I. Briartii* besteht nur aus zwei Zweigstückchen und ist im Hinblick auf Blüten äusserst unzureichend. E. Milne-Redhead hat nun im Moxico-Distrikt, am Lusava-Fluss sehr schönes Material gesammelt (n. 4080); hiervon stand mir auch eine Blüte in Spiritus konserviert zur Verfügung. Ich halte dieses Material u. a. auch auf Grund der Brakteen-Gestaltung zu *I. Briartii* De Wild. et Th. Dur. gehörig. Wie ich bereits früher ausgeführt habe (vgl. Fedde Repert. 39: 21-22. 1935), halte ich *I. Briartii* und *I. fissibractea* (Peter) G. M. Schulze (*) für zwei verschiedene, wenngleich sicher sehr nahe verwandte Taxa, vor allem auf Grund der Brakteen.

Gilg hat zu *I. Briartii* auch *I. Bagshawei* Bak. f. (in Journ. Linn. Soc. 37: 129-130. 1905) gestellt, und zwar nach der Diagnose. Das Originalmaterial hat er leider nicht gesehen. Dieses stammt aus Uganda, Kagera-Fluss (*Bagshawe* 552). Ich hatte Gelegenheit, dieses Material zu sehen. Leider wurde auch diese Art nach ausserordentlich unzureichendem Material beschrieben. Auf Grund der Gestaltung der Brakteen (das Material ist auch in dieser Hinsicht dürftig) bin ich zu dem Schluss gekommen, dass diese Art wohl mit *I. fissibractea* (Peter) G. M. Schulze übereinstimmt. Es ist durchaus möglich, dass dies auch für das Material *Dawe* 314 zutrifft, das ich allerdings noch nicht gesehen habe. Unter dem angolensischen Material fanden sich nun Exemplare, die ganz offensichtlich *I. Briartii* sehr nahe stehen, sich aber durch ihre durchschnittliche Tracht, durch ihre auffallende Kleinblütigkeit, durch die Brakteen, insbesondere aber durch die Kelchblätter, die keine seitlichen Tentakeln besitzen, von *I. Briartii* und *I. fissibractea* unterscheiden. Ich habe dieses Material als neue Art angesprochen *(I. Exellii)*.

Es ist natürlich zu bedauern, dass eigentlich nur das Merkmal der Brakteen- und Kelchblattgestaltung zur Unters-

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(*) Da ich damals versehentlich nicht die Korrekturabzüge erhielt, haben sich einige Druckfehler in die genannte Veröffentlichung eingeschlichen; es muss natürlich heissen S. 22,2. Absatz, Zeile 4: «... *(I. racemosa* DC., *Impatiens fissibractea* (Peter) G. M. Schulze comb. nov.).» Ferner 3. Absatz, Zeile 4: «... *I. fissibractea)*...».

cheidung dieser Formen gegenwärtig benutzt werden kann; aber über die Blüten von *I. Briartii* und *I. Bagshawei* ist nichts Hinreichendes bekannt.

3. BEMERKUNGEN ZU *I. DUTHIEAE* L. BOLUS

In bezug auf die Synonymie dieser Art vgl. B. L. Burtt in Kew Bull.: 161-163, 1938. Es ist dies eine der « schwierigsten » Arten. Offenbar scheint dieser Art *I. hochstetteri* Warb. sehr nahe zu stehen, jedoch meiner Meinung nach nicht *I. zombensis* Bak., wie dies Gilg annimmt (vgl. Bot. Jahrb. **43**: 114. 1909). Im allgemeinen rechnet man zu *I. duthieae* auch gewisses Material aus Transvaal, Natal und sogar Angola. Leider lässt das in bezug auf die Blüten unzureichende Herbarmaterial zurzeit noch keine wirklich kritische Durcharbeit dieser Art zu. Bereits Oliver (Flora Trop. Afr. **1**: 300. 1868), der gewisses Material aus Angola und Moçambique hierzu rechnet, schreibt: « This appears to be the same as the S. African plant found in Natal, Uitenhage, and the Orange Free State, but it is impossible to compare the dried flowers accurately. »

Gilg schrieb 1909 (Bot. Jahrb. **43**: 114) in bezug auf das Angola-Material, das er hierzu rechnete: « jedoch ist zu einer sicheren Identifizierung mein Material nicht ausreichend.» Besonders interessant ist nun auch das, was Burtt, der Gelegenheit hatte, das von Thunberg gesammelte Exemplar zu sehen, zu dieser Art bemerkt (Kew Bull.: 162. 1938): « The herbarium material is so unsatisfactory that a complete investigation of the South African balsams has not been practicable. Nevertheless it seems fairly certain that specimens from Natal and Transvaal hitherto referred to *I. capensis* Thunb. were wrongly identified.»

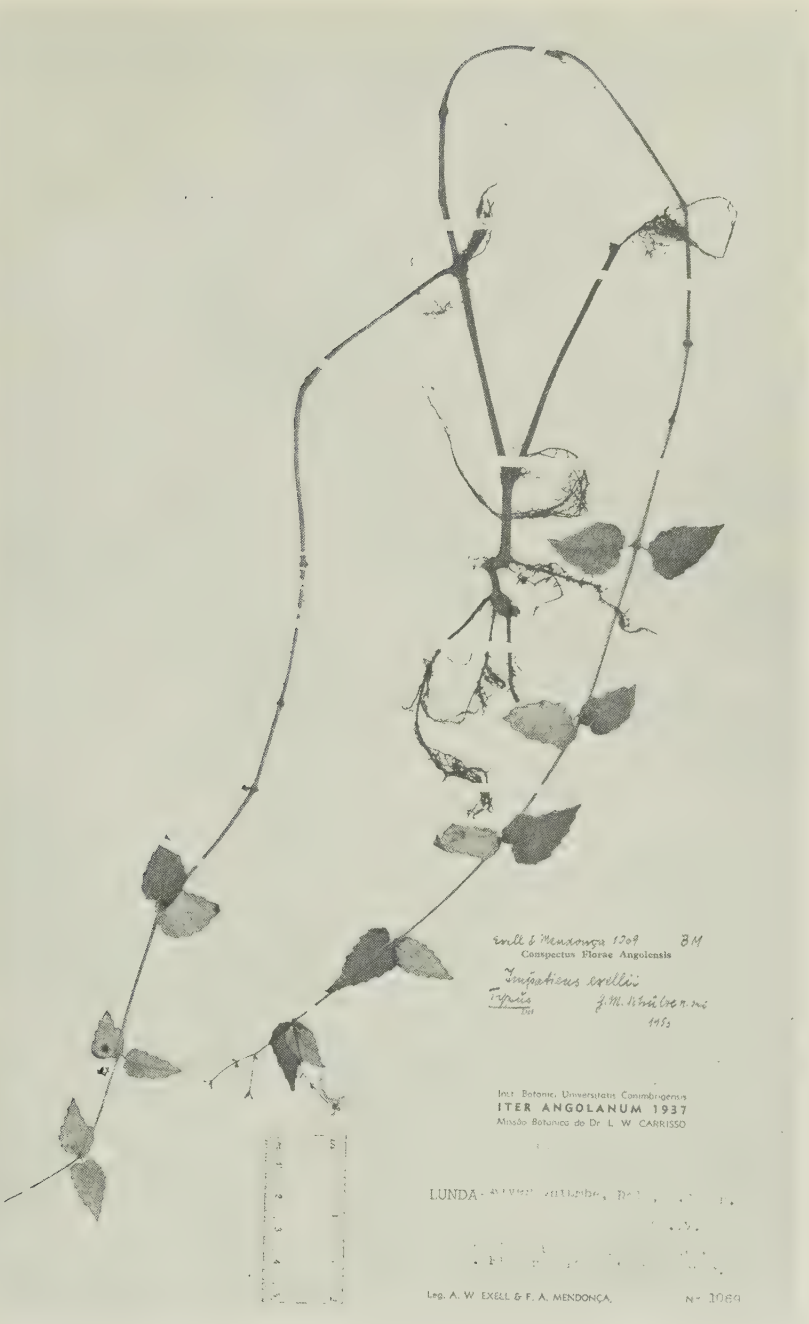
Ich kann Mr. Burtt nur zustimmen, dass es nach Herbarmaterial wohl kaum möglich sein wird, den Umfang dieser Art zu klären. Unterbrochen durch den letzten Krieg, habe ich danach wieder versucht, diese Frage aufzunehmen. Leider konnte meiner nach Südafrika selbst gerichteten Bitte, mir gut gesammeltes Material mit in flüssigem Medium konservierten Blüten zukommen zu lassen, noch nicht erfüllt werden. In neuester Zeit hat nun Jacques-Félix in Bull. de la Soc. Bot. Fr., **96**: 168-170. 1949 eine *Impatiens Jaegeri* von Franz. Guinea

und Sierra Leone beschrieben, die infolge eines früheren Homonyms jetzt den Namen *I. Jacquesii* Keay (vgl. Kew. Bull.: 287. 1953) erhalten hat. Sicher gehört auch diese Art in die nahe Verwandtschaft von *I. Duthieae*. Es ist sehr zu bedauern, dass auch dieser Art ausserordentlich unzureichendes Herbarmaterial zugrunde liegt, das die Klärung gewisser Fragen z. Zt. völlig unmöglich macht.

Es ist durchaus wahrscheinlich, dass das, was wir z. Zt. als *I. duthieae* ansprechen, in Wirklichkeit verschiedenen Taxa zuzuteilen ist, die sich jedoch nach Herbarexemplaren gegenwärtig noch nicht exakt trennen lassen.

So fand ich unter dem mir vorliegenden Angola-Material Exemplare, deren Blüten der *I. capensis* (nach Abbildung von Marloth, Fl. S. Afr. 2, 2: 149, 150 und t. 50. 1925) gleichen, in den Blättern jedoch nach *I. Jacquesii* Keay tendieren.

Da offenbar eine Gruppe von untereinander sehr nahe stehenden Formen vorliegt, die aus gegenwärtig nach Herbarmaterial noch nicht eindeutig identifizierbaren Taxa besteht, so halte ich es für angeraten, vorläufig noch auch die in diese Formengruppe gehörenden angolensischen Exemplare als *I. Duthieae* L. Bolus im weiteren Sinne (sens. lat.) zu bezeichnen, wobei man sich jedoch des tatsächlichen Wertes dieser Bezeichnung bewusst sein muss.



Impatiens Exellii G. M. SCHULZE

Impatiens Mendonçae G. M. SCHULZE

Impatiens Gossweileri G. M. SCHULZE

A NEW GENUS OF *LEGUMINOSAE (CAESALPINIOIDEAE)* FROM GABON AND CABINDA

by

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Librevillea Hoyle gen. nov. (Leguminosae-Caesalpinioideae--Amherstieae) (Tab. I, II et III).

Flores pedicellati, multiseriati, parvi, in paniculis terminalibus axillaribusque dispositi; bracteolae subcoriaceae, alabastrum valvatim cingentes, persistentes. *Receptaculum* brevissime cupulare, intus infra stamina leviter incrassatum cum disco glanduloso c. 10-lobulato. *Tepala* 2 (rare tantum 1), minima, subpetaloidea (?), bracteolis alternantia. *Stamina* 10 (rarissime 9), vix ultra discum connata, alternis longiusculis; antherae subglobosae, medifixae, longitudinaliter dehiscentes, pollen laevis. *Ovarium* stipitatum, oblongum, lateraliter compressum, lanatum, glabrescens; stipes liber, basi in receptaculo insertus, vix longitudinaliter accrescens; stylus filiformis, quam filamentis brevior, subglaber, stigmate minimo subtruncato; ovula 2. *Legumen* dehiscens, breviter stipitatum, oblongum vel naviculiforme, compressum, sublignosum, glabrum, rostro obliquo subterminale productum; suturae leviter incrassatae, posteriora haud tamen alata; semen 1 (rarissime 2), planum, subrotundatum; hilum parvum. Arbor alta foliis pinnatis petiolatis; stipulae intrapetiolares, basi persistentes, connatae et subtruncatae; foliola alterna vel rarissime opposita, petiolulata, epunctata, basi subaequilatera. Species unica *L. Klainei* (Pierre ex Harms) Hoyle.

This genus resembles *Brachystegia* Benth. (whence it is now being removed) in the form of the receptacle and androecium, in having a greatly reduced perianth and in the persistent, intrapetiolar, connate base of the stipules; it differs in the

venation of the tepals (which suggest reduced petals rather than sepals), in the pod without winged adaxial suture and in the alternate, petiolulate leaflets with symmetrical nervation at the base. *Brachystegia* shows petiolulate leaflets in only one species, and alternate leaflets only abnormally, while the asymmetric base of the leaflet with secondary nerves departing fanwise on one side of the midrib is characteristic and universal. Preliminary examination of the pollen-grain shows that of *Brachystegia* to be deeply grooved with the lobes strongly areolate; in *Librevillea* the grain is smooth with inconspicuous grooves.

There is a superficial resemblance in the alternate leaflets, the persistent base of the stipules and the general appearance of the inflorescence-axis, between *Librevillea* and *Oddoniodendron* De Wild., but their affinity does not seem at all close, the latter genus having a well-developed perianth on a broadly cupular receptacle. *Librevillea* also superficially resembles *Crudia*, *Oxystigma* and *Gossweilerodendron* in leaves and inflorescence.

Typus: **Librevillea Klainei** (Pierre ex Harms) Hoyle, comb. nov.; *Brachystegia Klainei* Pierre ex Harms in Engl. Bot. Jahrb. XL: 30 (1907); Burtt Davy & Hutch. in Bull. Misc. Inf. Kew 1923: 157; Bak. f. in Journ. of Bot. LXVI, Suppl. 1: 146 (1928); Legum. Trop. Afr.: 733 (1930); Pellegrin, Legum. Gabon: 72 (1948).

Now that more material is available together with more information on the tree in the field, illustrated by excellent photographs taken by Mons. Aubréville (Tab. II, III), it seems desirable to publish here an emended and amplified description of the species.

A large, forest tree 12-35 m high, 1.2 m diameter, with large, much-branched crown and buttressed base; bark pale yellow when cut, exfoliating in thin, dry, oblong scales. *Branchlets* cylindrical, crispate-puberulous and slowly glabrescent, or glabrous, soon becoming striate or reticulate with brown epidermal striations on the exposed paler cortex. *Stipules* apparently consisting, usually, only of the very short, connate, persistent, intrapetiolar portion, 1-2 mm long, truncate or

emarginate, puberulous (supporting the base of the pulvinus and at first enclosing the pubescent axillary bud) sometimes bearing at the apex 2 minute, conical points ([1]), which are caducous leaving minute scars. *Leaves* pinnate, regularly distributed on the branchlets at intervals of (1) 2-5 cm; petiole (2) 6-10 mm long, puberulous or glabrous, one third to half consisting of the rugose pulvinus; rhachis slender, (1.5) 2-5 cm long, narrowly channelled, sulcate when dry, puberulous and scarcely glabrescent, or glabrous; leaflets (2) 3-5 (6), alternate or very rarely opposite on 3-4 mm long, usually puberulous, rugose, often twisted petiolules; lamina (4) 5-9 (12) cm long, (1.5) 2-4 (5) cm broad, oblong- or elliptic-lanceolate to ovate, usually somewhat falcate, coriaceous especially in age, apex caudate or broadly acuminate, acumen up to 2 cm long, obtuse or acute and often mucronulate, base subsymmetrically rounded to cuneate, margin subrevolute and sometimes undulate when dry; upper surface obscurely reticulate, shining, glabrous, lower surface very finely reticulate, scarcely shining, glabrous except for sparse puberulence on the midrib and near the base at first; midrib usually somewhat excentric, rarely central, impressed above, prominent and sulcate when dry beneath, principal secondary nerves 6-8 (10), obscure, doubly looped within the margin, the few intermediate secondary nerves scarcely less conspicuous. *Inflorescences* racemose, paniculate, many-flowered, terminal or terminal and axillary, 6-13 cm long and broad, often in pairs or threes, usually twice branched rather remotely; peduncle (0.5) 1-2 (3) cm long, like the slender axis puberulous or tomentellous, branches very slender, spreading, sulcate when dry, puberulous; bracts fugacious, apparently 0.5 mm long, ovate, puberulous; pedicels very slender, 3-6 mm long, pinkish--tomentellous, usually subverticillate in fours, threes or pairs, accrescent in thickness, but scarcely in length, in fruit. *Flowers* bluish-white, 7-9 mm across including the persistent, suborbicular, semi-cupular bracteoles, 3.5-4.5 mm long, at first valvately enclosing the flower in bud, later spreading, pinkish-puberulous outside especially on the margin, more sparsely so within.

([1]) No young, sterile branchlets are available; the stipules may be larger on these.

Receptacle very shortly cupular, less than 0.5 mm long, about 0.5 mm broad at the base, increasing upwards to about 1 mm broad, glabrous, thickened within, below the insertion of the stamens, into a disc of about 10 glandular swellings. *Tepals* 2 (rarely 1 only), white, ovate elliptic, obtuse, (0.5) 1-1.5 (2) mm long, puberulous outside, glabrous within except the densely ciliate margin, inserted very close to the base of the receptacle, alternate with the bracteoles. *Stamens* 10 (very rarely 9), scarcely united beyond the disc, filaments 4.5-5 (6) mm long, alternately long and short, filiform, flattened towards the base, incurved towards the apex, glabrous; anthers medifixed, subglobose, 1 mm in diameter. *Ovary* stipitate, oblong-fusiform, scarcely 2 mm long, 1 mm broad, yellowish lanate, slowly glabrescent; style 3-4 mm long, reddish-violet, filiform, glabrous, stigma very small, subtruncate; stipe 0.5-1 mm long, glabrous, arising from the base of the scarcely wider receptacle. *Ovules* 2. *Pod* oblong-naviculiform or oblanceolate, flat, (4.5) 6-9 (10) cm long, 2.5-4 (4.5) cm broad, base rounded, apex rounded to obliquely subtruncate; sutures slightly thickened, the adaxial curved especially in the region of the seed(s), terminating in an obliquely erect, acutely acuminate beak 2.4 mm long; valves at length subwoody, shining or pruinose, obscurely and obliquely venose-reticulate, dehiscing elastically and rolling up, tending to split into two layers; stipe (1) 2-4 (5) mm long, 3-4 mm thick, glabrescent, attached at an angle of 60°-90°. *Seed* usually 1 only (very rarely 2), discoid to oblong-elliptic or irregularly rhombic (abnormally ?), up to about 2.5 cm long, 2 cm broad, lenticular in section, the hilum shortly protuberant, about 2 mm across; cotyledons flat, green.

Gabon: *Chalot* 41 (K); *Bertin* (Mission, 1917) in hb. *Fleury* (P); *Klaine* 7 (FHO, K), 260 (P); near Libreville, *Aubréville* 95 (P), *Klaine* 8 (E, K, P holotype), 420 (P), 3260 (BM, K, P), 3315 (K, P) [1], *Morel* s. n. (P); Réserve forestière de la Mondah, *S. F.* s. n., *SRF* 5 (P); near Ebimangha on L. Ayem (Cercle de Ndjolé), *Fleury* in hb. *Chev.* 26626 (P); L. Zonangué, *Corbet* SRFG 1107 (FHO); C. Estérias, *M. Groulez* SRFG

[1] This number was mis-read as 3319 by Burtt Davy & Hutch., l. c.

1173 (FHO); Fernan Vaz, R. Olandé, «sur Permis Marsot», *E. Raynaud* s. n. (P); Mayumba, *Lecomte* B. B. 12, E. 56 (P); Cocobeach, near Nkan below the Mdughi-Noya confluence, *Morel* SRFG 15 (P); near Lambaréné, Rèserve de Zilé, *D. Normand* s. n. (Bois DN 244) (P); Mondorobé, *H. Pobéguin* 51 (P); lower Kouilou, *Sargos* 105 (P); Hte. Ngounyé, *Le Testu* 6399 (P).

ANGOLA. Cabinda: Belize, banks of R. Luali near the Official Residence, *Gossweiler* 7615 (BM, COI, K, LISU, LISJC), 7615 b (BM, LISJC).

Vernac.: PANDYA, EBÉBILIBA (Pahouin), NGABA (Fang), BANGA, BANDA blanc, ORANGA, M'PANG.

Uses: Wood white, very hard, with dusky heartwood, reputed rot-proof.

Distrib.: Rather common in the forest of Libreville; sandy soils near Mayumba lagoon; wetter parts of Mondah forest, particularly in seasonally flooded ground behind the mangrove; very frequent in the region of Fernan Vaz, where it occurs in populations; scattered in the Pluviisilva of stony hills at Belize.

Fl.: Mar.-Dec. Fr.: Mar.-Nov.

Notes: The bark is described by AUBRÉVILLE in lit. (referring to *Groulez* SRFG 1173) as «gris blanc» and by GOSSWEILER (no. 7615) as «dusky red brown»; they agree that it is scaly. Mons. AUBRÉVILLE undertook at my request to supervise the collection of *Groulez* SRFG 1173 (from the tree of which he took the accompanying photographs of the Tab. II and III) and also of *Corbet* SRFG 1107; for these and his descriptive letter I am very grateful. The record of «tepals white» is from *Klaine* 420; he may have mistaken the bracteoles for «petals». Whether the tepals are in fact reduced petals or sepals, or even one of each (as suggested by HARMS, *l. c.*) remains a matter for conjecture.

GOSSWEILER describes the tree as «deciduous just before flowering (in big specimens only)»; it is, to judge from the specimens, certainly not evergreen.

Librevillea Klainei (PIERRE ex HARMS) HOYLE

a) Flowering branchlet (×1/2). b) Flower (×4). c) Gynaecium (×4). d) Androecium (×4). e) Tepals (×12). f) Larger tepals from another specimen (×12). g) Flower in median section (×5). h) Lower surface of leaflet (×1). i) Fruiting branchlet (×1/2). j) Seed (×1/2). k) Fruit, immature (×1/2). a-e & h from *Klaine* 8; f & g from *Corbet* SRFG 1107; i & j from *Groulez* SRFG 1173; k from *Morel* s. n.

Foto Aubréville

Librevillea Klainei (Pierre ex Harms) Hoyle

Foto Aubréville

Librevillea Klainei (PIERRE ex HARMS) HOYLE

SUR LE TURRAEA THOUARSIANA (BAILL.) CAVACO ET KERAUDREN, COMB. NOV. ET UNE ESPÈCE NOUVELLE D'*OLAX*

par

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Chargé de Recherches du C. N. R. S. au Muséum de Paris

et

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I. Sur le *Turraea thouarsiana* (Baill.) Cavaco et Keraudren, *comb. nov.*

Baillon dans son Mémoire sur les *Loranthacées* publié dans le vol. III d'Adansonia (1862-63) décrivit p. 121, une espèce nouvelle d'*Olax* recoltée à Madagascar par Du Petit-Thouars, l'*Olax thouarsiana*, qu'il a rangée dans la section *Pseudaleia* (Pet.-Thou.) Baill. (= *Pseudaleia* Pet.-Thou. pro gen. = *Pseudaleioides* Pet.-Thou. pro gen.). Il en a donné la description suivante: « ramulis distichis nutantibus striatis; foliis alternis obovatis integerrimis coriaceis nitidis venosis; floribus puberulis racemosis; calycodio obsolete dentato ».

Palachy cite l'*Olax thouarsiana* dans son « Catalogus Plantarum Madagascariensium », vol. V, 1907, p. 46.

Sleumer, en publiant les « Olacacées » dans la 2ème édition des « Pflanzenfamilien » (1935), range l'*Olax thouarsiana* avec deux espèces de l'ouest Africain, l'*Olax schlechteri* Engl. et l'*Olax pynaertii* De Wild., dans la sect. *Estaminodiales* Engl. caractérisée, comme chacun sait, par les étamines en nombre de 6 et l'absence de staminodes.

En revisant la famille des *Olacacées* en vue de sa publication dans la « Flore de Madagascar et des Comores » qui se publie sous la direction du Professeur H. Humbert, nous avons été amenés à analyser les fleurs de l'échantillon-type de l'*Olax thouarsiana* Baill. et nous avons eu la surprise de constater que cette plante n'appartient pas à la famille des *Olacacées* mais à celle des *Meliacées !*

Les fleurs axillaires à calice cupuliforme légèrement denté, donnent à cette plante l'aspect d'un *Olax*. Le célèbre botaniste Baillon n'a pas dû disséquer les fleurs, puisque dans la description de son espèce citée ci-dessus, il indique seulement les caractères suivants: « Floribus puberulis racemosis; calycodio obsolete dentato ». C'est d'après l'aspect extérieur des fleurs qu'il s'est cru en présence d'une Olacacée.

Position systématique du taxon. — On peut constater selon la description de cette espèce que nous donnons ci-dessous et d'après l'examen de la figure ci-incluse, qu'elle appartient au genre *Turraea* L. tel qu'on le conçoit Harms dans la 2ème édition des « Pflanzenfamilien », 1940, p. 85, devant être rangée dans la section *Euquivisia* C. DC. Monogr. (1878) 428, et placée à côté du *Turraea ovata* (Cav.) Harms dont elle se distingue par ses fleurs plus petites à pédicelles plus courts, non densément tomenteux, par ses pétales spatulés, par le rapport entre la longueur du calice et de la corolle, par ses anthères allongées, etc.

Turraea thouarsiana (Baillon) Cavaco et Keraudren, **comb. nov.** (Tab. I). — *Olax thouarsiana* Baill. in Adansonia, III (1862-63) 121.

Frutex (?); ramis secundariis distichis striatis, ramuli juniores pubescentes. Folia alterna vel sobopposita, exstipulata, coriacea, integra, glaucescentia, glabra, ovata vel elliptica, apice obtusa basi attenuata, 2-3 cm longa, 15-17 mm lata; nervis secundariis subalternis, subtilibus, adscendentibus, utrinque circiter 10; petioli circiter 3 mm longi, pilosuli, supra sulcati. Flores hermaphroditi in cymas axillares recemiformes dispositi; calyx cupuliformis (2 × 1,5 mm), 4-dentatus, extus pubescens; petala 4, in aestivatione valvata, 5 mm longa, 1,5 mm lata, spatulata, extus puberulis. Stamina 8 in tubum antheriferum cylindricum quam petala breviorem, antheris tubo exsertis 1 mm longis, mucronulatis. Discus nullus. Ovarium 4-loculare, 2-ovulatis 1 mm longum; ovula collateralia; stylus ovarium superans, 3 mm longus; stigmate capitato apice 4-dentulo terminatus. Fructus...

Typus in Herb. Mus. Par.

II. Une espèce nouvelle d'*Olax*.

Nous allons décrire une plante très curieuse par son calice très accrescent, en coupe, comme celui de l'*Olax obtusa* Bl. de l'Asie ou de l'*Olax madagascariensis* Pet.-Thou.

Olax tsaratananensis Cavaco et Keraudren, sp. nov. (Tab. II). Arbor 8-12 m alta, ramuli glabri. Folia alterna, exstipulata, subsessilia, integra, coriacea, glabra, ovata, apice basique obtusa, 3-4 cm longa, 2-2,5 cm lata, nervi laterales inconspicuis ; petioli 2 mm longi, crassi, glabri. Flores racemosi ; inflorescentia 1,5 cm longa ; pedicelli 7-10 mm longi, glabri ; calyx cupuliformis, 2-10 mm longus ; ovarium 2-loculare, ovulis solitariis, stigmate 3-lobato.

Arbre de 8-12 m à feuilles persistantes ; environs de Tsaratanana, alt. 1500 m, *Perrier de la Bâthie* 2008.

Espèce endémique de Madagascar bien distincte de toutes les autres.

Les fleurs ont perdu leurs pétales et leurs étamines et sont à un stade avancé formant presque des fruits. Aussi nous est-il impossible de les décrire.

TABULARUM EXPLICATIO

TAB. I

Turraea thouarsiana (Baill.) Cavaco et Keraudren

1 — Rameau florifère, gr. nat.
2 — Bouton, × 9.
3 — Bouton, 2 pétales enlevés, × 9.
4 — Coupe verticale du calice et de l'ovaire, pétales et androcée enlevés, × 12.
5 — Coupe transversale du calice et de l'ovaire, × 16.
6 — Stigmate, × 24.

Turraea thouarsiana (Bail.) Cavaco et Keraudren

Olax tsaratananensis Cavaco et Keraudren

1 — Rameau avec fleurs et fruits, × 2/3.
2 — Fleur à un stade avancé, × 2.
3 — Coupe verticale de la fleur, × 2.

NOVIDADES DA FLORA DE ANGOLA

IV

por

A. W. EXELL e F. A. MENDONÇA

Abutilon Pritchardii Exell & Hillcoat, sp. nov. (Malvaceae).

Herba perennis 1-1.2 m alta, caulibus erectis stellato-tomentosis, glanduloso-pubescentibus et pilosis vel hirsutis. *Folia* stipulata, stipulis lineari-lanceolatis 7 × 1.5 mm, petiolata, petiolo 2-8 cm longo indumento eo caulium simili, lamina ovato-cordata, 3-8 × 3-6.5 cm, basi 7-nervia, margine serrata, apice acuminata, omnino dense stellato-tomentosa. *Flores* aurantiaci, pedicellis 8-10 mm longis, pedunculis 3-5 cm longis indumento eo caulium simili, in paniculas foliatas dispositi. *Sepala* ovato-lanceolata, 12 × 6 mm, stellato-tomentosa, apice apiculato-acuminata, ad medium connata. *Petala* 17-18 mm longa, glabra. *Columna staminea* 7 mm longa, glabra, filamentorum partibus liberis 3 mm longis. *Ovarium* depresso-subglobosum, tomentosum, stylis 4-5 mm longis. *Carpella* 12-15, 9-11 × 4-5 mm, margine exteriore stellato-tomentosa ceteroque glabra, apice rotundata et breviter rostrata, columna centrali 4 mm longa, seminibus subreniformibus, 2 × 2 mm, minutissime stellato-puberulis.

Huíla: Pocolo, *Pritchard* 374 (BM, type; Coi; Lis. C).

This species is very close in appearance and indumentum to *A. Mendoncae* Bak. f. (fig. 1 *a*) but has carpels nearly twice as large (fig. 1 *b*) and a closer, finer serration of the leaves. *A. hirtum* (Lam.) Sweet also has a similar indumentum but in this species the carpels (fig. 1 *c*) are half as large again, more rounded and with a shorter apical point, and the central column of the capsule is only about half as long. *A. Pritchardii*

is in some respects intermediate between *A. Mendoncae* and *A. hirtum* but it is improbable that it is a hybrid between them as there is no evidence that their ranges overlap and *A. Pritchardii* was found at a locality where neither is known.

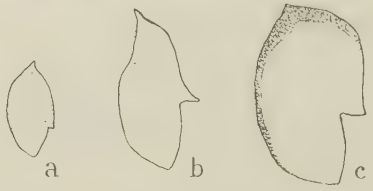


Fig. 1. — Vertical sections of carpels of: (a) *Abutilon Mendoncae* Bak. f. (*Exell & Mendonça* 2179); (b) *Abutilon Pritchardii* Exell & Hillcoat (*Pritchard* 374); (c) *Abutilon hirtum* (Lam.) Sweet (*Exell & Mendonça* 2686).

There seem to exist in southern Angola several species of *Abutilon* with restricted distribution, related to each other but quite clearly differentiated and distinguishable by a number of characters.

Although the new species was collected growing in builders' waste in a half-built house, there is no reason to suppose that it is an introduced plant for it seems definitely to belong to a group of species many of which are endemic in southern Angola and neighbouring territories.

[A. W. E & D. H.]

Cassia africana (Steyaert) Mendonça & Torre, sp. nov. Tab. I-A (Leguminosae).

Cassia mimosoides var. *africana* Steyaert in Bull. Jard. Bot. Etat Brux. XX: 247 (1950) pro parte quoad specim. angol.

[*Cassia mimosoides* sensu Hiern, Cat. Afr. Pl. Welw. I: 293 (1896) pro parte quoad specim. Welw. 1718 et 1719. — Harms in Warb., Kunene-Samb.-Exped. Baum: 251 (1903)].

Cassia capensis forma Bak. f. in Journ. of Bot. LXVI, Suppl. Polypet.: 136 (1928).

Obs. — Ainda que a diagnose de STEYAERT seja legìtimamente válida, entendemos que pode ser útil publicar uma descrição mais ampla da espécie, fundamentada na observação do material abundante de que dispomos agora.

Suffrutex rhizomatosus multicaulis, caulibus subsimplicibus gracilibus rubiginosis 10-40 cm altis adpresso-pubescentibus demum glabrescentibus. *Folia* 1.5-6 cm longa, stipulata, stipulis ovato-subauriculatis cuspidato-subulatis conspicue 3-4-nerviis, rhachide cristata, petiolo brevi, glandula petiolari sessili orbiculari-cupuliformi, foliolis 5-30-jugatis, asymmetricis basi auriculatis vel subauriculatis oblique oblongo-ellipticis vel linearibus apice oblique acutis mucronatis, 3-4 mm longis, nervis valde obsoletis. *Flores* 20-25 mm in diam. in racemos axillares vel supra-axillares 1-3-floros, pedunculis ad caulem adnatis vel nonnunquam liberis, pedicellis capillaribus 2-4.5 cm longis apice bracteolatis, bracteolis lanceolato-subulatis scariosis 2-3 mm longis, dispositi. *Sepala* lanceolata ± 7 mm longa subsericea, exteriora lanceolato-subulata, interiora latiora lanceolata. *Petala* breviter unguiculata elliptica vel obovata usque 12 mm longa. *Stamina* 10, 4 majora, 6 minora, filamentis brevibus 0.4-1 mm longis, antheris 4-6 mm longis. *Ovarium* sessile lineare dense albo-villosum pluriovulatum, stylo arcuato glabrescente ovario breviore. *Legumen* lineari-oblongum pubescens, 25-35×2.5-3 mm, valvis coriaceis.

Cuanza Norte: Cazengo, Vila Salazar, *Gossweiler* s. n. (Lis. U).

Malange: Quizanga, próx. de Malange, *Gossweiler* 1393 (BM).

Benguela: Caconda, *Anchieta* 23 (BM; Lis. U), 82 (Lis. U), 101 (Lis. U); sem localidade precisa, *Castro* 226 (BM; Coi); Alto Catumbela, *H. G. Faulkner* 241 (BM); Cuima, *Gossweiler* 12556 (BM); entre Ganda e Caconda, *Hundt* 24 (BM), 681 (BM; K, tipo); Nova Lisboa, *Tisserant* A 139 (Coi).

Huíla: Humpata, *Amado* s. n. (Coi); Huíla, *Antunes* 325 (Coi; Lis. C), s. n. (Coi; Lis. C; Lis. U); rio Chitanda, próx. de Cassinga, *Baum* 219 (BM; Coi; K); Humpata, Chivinguiro, *Gossweiler* 12794 (Lis. C); Catumbe, *Welwitsch* 1718 (BM; Lis. U); Huíla, Mumpula, *Welwitsch* 1719 (BM; Lis. U).

Esta nova espécie relaciona-se com *C. capensis* Thunb., da qual difere pelo hábito cespitoso, caules erectos subsimples, rizoma robusto, em regra estolonífero. De *C. mimosoides* separa-se nìtidamente pelo hábito lenhoso e flores muito maiores.

[F. A. M. & A. R. T.]

Cassia Newtonii Mendonça & Torre, sp. nov. Tab. I-D.

Suffrutex vel *herba* perennis sparse villoso-pubescens, caulibus ramosis c. 30 cm altis. *Folia* 1.5-6 cm longa stipulata, stipulis lanceolatis basi subauriculatis apice subulatis 5-7 mm longis, nervis conspicuis, rhachide canaliculata villoso-pubescente, petiolo 1.5-2.5 mm longo, glandula petiolari sessili orbiculari-cupuliformi, foliolis 10-20-jugatis asymmetricis basi auriculatis oblongo-ellipticis oblique acutis mucronatis, 4-6 × 1-1.5 mm, margine ciliolatis. *Flores* 12-15 mm in diam., pedicellati, pedicello 8-15 mm longo pubescente apicem versus bracteolato, bracteolis lanceolato--subulatis c. 2 mm longis, in racemos abbreviatos paucifloros supra-axillares dispositi vel nonnunquam solitarii. *Sepala* elliptica apiculata 6-8 mm longa pubescentia. *Petala* unguiculata obovata vel elliptica 8-10 mm longa. *Stamina* 9 (10), 4 majora, 5 (6) minora, filamentis brevibus 0.3-0.8 mm longis, antheris 2-3.5 mm longis. *Ovarium* sessile lineare dense sericeum pluri-ovulatum, stylo arcuato fere glabro, ovario breviore. *Legumen* linear-i--oblongum pubescens, 30-35 × 3-3.5 mm, valvis coriaceis.

Huíla: sem localidade precisa, *Newton* 98 (Coi, tipo).

Esta espécie distingue-se de *C. mimosoides* L. pelo hábito sufrutescente, folhas menores, com o raquis canaliculado, não cristado. De *C. capensis* Thunb. difere pelas flores menores e pedicelos mais curtos que a folha.

O espécime de Welwitsch n.º 1720 (BM, Lis. U), proveniente de Huila, Empalanca, citado por Hiern (Cat. Afr. Pl. Welw. I: 293 (1886), pertence talvez aqui.

[F. A. M. & A. R. T.]

Cassia huillensis Welw. ex Mendonça & Torre, sp. nov. Tab. I-E.

Cassia Kirkii Oliv., Fl. Trop. Afr. II: 281 (1871) pro parte quoad specim. Angol. — Hiern, Cat. Afr. Pl. Welw. I: 294 (1896). — Steyaert in Bull. Jard. Bot. Etat Brux. XX: 253 (1950) pro parte quoad specim. Welw. 1721.

Suffrutex erectus usque 1.5 m altus, caulibus ramosis teretibus tomentosis. *Folia* 4-10 cm longa petiolata, petiolo 2.5-4 mm longo, stipulata, stipulis lanceolato-subulatis, 7-10 mm longis, nervis conspicuis, glandula petiolari sessili oblonga ± 1.5 mm longa, rhachide supra canaliculata, foliolis 15-35-jugatis asymmetricis oblongo-ellipticis basi auriculatis apice obtusis vel subacutis oblique mucronulatis 7-15 × 3-5 mm, nervis conspicuis. *Racemi* axillares vel supra-axillares bracteati 2-4-flores breviter pedunculati, pedicellis 12-15 mm longis apicem versus bracteolatis, bracteolis ovato-subulatis 4-4.5 mm longis dense pubescentibus. *Sepala* elliptica acuminata 10-12 mm longa pubescentia. *Petala* unguiculata obovata 12-14 × 8-10 mm. *Stamina* 9 (10) filamentis brevibus c. 1.5 mm longis, antheris 4-6 mm longis. *Ovarium* sessile anguste oblongum dense sericeum pluri-ovulatum, stylo arcuato glabro. *Legumen* oblongum primo pubescens nonnunquam demum glabrescens, 40-60 × 4-8 mm, valvis coriaceis; semina 10-12 oblique applanato-ovoidea glabra nitida usque 4-5 × 3 mm.

Benguela: Caconda, *Capello & Ivens* 71 (Lis. U).

Huíla: Huila, *Antunes* 2 (Coi; Lis. C); Huíla, *Capello & Ivens* 47 (Coi); Monhino, *Dekindt* 297 (Lis. C), 447 (Lis. C), s. n. (Lis. C); entre Sá da Bandeira e Humpata, *Exell & Mendonça* 1971 (BM; Coi), Gambos, Quilemba, *Exell & Mendonça* 2538 (BM; Coi); Humpata, *Gossweiler* 10758 (Coi; K); Humpata, Palanca, alt. 1900 m, *A. Monteiro* 43 A (Coi); Humpata, *Newton* 217 (Coi); Humpata, *Pearson* 2106 (K); Huíla, entre Eme e Monhino, *Welwitsch* 1721 (BM; Coi; K; Lis. U, tipo).

C. huillensis é tìpicamente uma espécie arbustiva, de 1-2 m de altura, ramosa e fortemente lenhosa, com os ramos folhosos densamente tomentoso-canescentes, enquanto que *C. Kirkii* é erva vivaz de caules simples virgados, medulosos, com pubescência mais ou menos esparsa.

[F. A. M. & A. R. T.]

Cassia biensis (Steyaert) Mendonça & Torre, sp. nov. Tab. I-C.

Cassia katangensis var. *biensis* Steyaert in Bull. Jard. Bot. Etat Brux. XX: 260, t. 10, fig. E-F (1952).

Bié: Silva Porto, alt. 1600 m, *Cardoso* s. n. (Lis. JC); Bela Vista, *Fenaroli* 1336 (Herb. Fenaroli); Bié, *Gossweiler* (Br, tipo).

Huíla: Huíla, *Dekindt* s. n. (Lis. C).

Steyaert, loc. cit., do mesmo passo que eleva à categoria de espécie parte de var. *katangensis* Ghesq. de *C. fallacina*, descreve sobre o espécime Gossweiler 9 (B), a var. *biensis* da sua nova espécie *C. katangensis*. O cotejo dos materiais que assimilamos à variedade de Steyaert leva-nos à conclusão de que é mais satisfatório atribuir aquele taxon à categoria de espécie.

As já numerosas espécies do suposto ciclo de afinidades de *C. mimosoides* são tão difíceis de separar como impossível de as reunir. Novos e muito mais numerosos materiais são necessários para esclarecer este complexo problema.

[F. A. M. & A. R. T.]

Cassia Fenarolii Mendonça & Torre, sp. nov. Tab. I-B.

Suffrutex rhizomatosus prostratus vel suberectus tomentosus multicaulis, basi ramosissimus, ramis usque 20 cm longis. *Folia* 1.5-5 cm longa, breviter petiolata, petiolo 1.5-2.5 mm longo, stipulata, stipulis lanceolato-subulatis 5-6 mm longis nervis conspicuis, rhachide canaliculata pubescente, glandula petiolari pediculata orbiculari-cupuliformi, foliolis 10-35-jugatis asymmetricis oblongo-lanceolatis 4-6 × 0.5-1 mm basi auriculatis margine saepe ciliolatis apice oblique acutis. *Flores* pedicellati, pedicello 10-13 mm longo pubescente apicem versus bracteolato, bracteolis lanceolato-acutis c. 1.5 mm longis, in racemos abbreviatos paucifloros supra-axillares dispositi vel nonnunquam solitarii. *Sepala* oblongo-lanceolata apiculata 6 mm longa pubescentia. *Petala* unguiculata obovata glabra 7 mm longa. *Stamina* 8 (10) filamentis brevibus 0.6-1 mm longis, antheris 2-3 mm longis. *Ovarium* sessile lineare dense sericeum, pluri-ovulatum, stylo arcuato fere glabro ovario breviore, stigmate discoideo. *Legumen* maturum adhuc ignotum.

Benguela: próx. de Elende, *Wellman* 1807 (K).

Bié: próx. de Chinguar, *Fenaroli* 1108 a (Herb. Fenaroli, tipo).

Esta espécie separa-se de *C. capensis* Thunb. pelas flores menores e pedicelos mais curtos que as folhas, de *C. Newtonii* Mendonça & Torre pelas glândulas peciolares pediculadas, e folíolos mais estreitos.

[F. A. M. & A. R. T.]

Bauhinia Exellii Torre & Hillcoat, sp. nov. Tab. II (Leguminosae).

Frutex rhizomatosus ad 0.8 m altus, ramulis glabris. *Folia* petiolata, petiolo 7-12 mm longo glabro, stipulata, stipulis lanceolato-linearibus 5-6 mm longis glabris caducis, lamina cordata alte bilobata vel ad basin fissa, lobis oblique ovato-ellipticis vel ellipticis, 2-4.5 × 1.2-3 cm, basi trinerviis supra subtusque conspicue reticulatis. *Flores* pedicellati, pedicello 2-5 mm longo ferrugineo-tomentoso, in racemos breves paucifloros terminales et axillares ferrugineo-tomentosos bracteatos, bracteis minimis caducis, dispositi. *Alabastra* clavata, calycis segmentis apice subulatis. *Calyx* subspathaceus ferrugineo-tomentosus, tubo cylindrico striato 8-10 mm longo, segmentis ligulatis 15-20 mm longis basi valvatis apice paullo imbricatis cohaerentibus. *Petala* purpureo-rosea unguiculata, ungue 4-7 mm longo sparse piloso, limbo elliptico vel oblongo, 2.5-4 × 1.5-2 cm, basi truncato et breviter cuneato in unguem decurrente penninervio margine undulato-crispo. *Stamina* fertilia 5, ad basin libera, 3 longiora cum 2 breviora alternantia, antheris dorsifixis c. 4 mm longis, sterilia 5 in ligulam 15 × 1.5 mm sparse pilosam connata. *Ovarium* oblongum pluri-ovulatum longe stipitatum, stipite 10-15 mm longo, fulvo-tomentosum, stylo 8 mm longo, stigmate capitato umbraculiformi. *Legumen* coriaceum oblongum basin versus attenuatum, c. 8-10 × 1.5-1.8 cm, primo tomentosum demum pubescens.

Lunda: Dala, alt. 1230 m, 29-IV-1937, *Exell & Mendonça* 1461 (BM; Coi, tipo); Dala, rio Chiumbe, *Gossweiler* 11198 (Coi; K), 11198 b (Coi).

« Subarbusto rizomatoso de 0.5 m; flores purpúrec-róseas ».

Nome vernáculo: Mucunjacunja (Quioco).

Esta espécie relaciona-se com *B. Bowkeri* Harv. da qual difere pela forma das folhas, fendidas até à base ou quase, pelo tubo do cálice e estipe muito mais curtos.

[A. R. T. & D. H.]

Bauhinia Mendoncae Torre & Hillcoat, sp. nov.

Bauhinia Serpae sensu Bak. f. in Journ. of Bot. LXVI, Suppl. Polypet.: 138 (1928) pro parte excl. specim. Gossw. 2986; Legum. Trop. Afr.: 656 (1930) pro parte quoad specim. Gossw.; in Bol. Soc. Brot. Sér. 2, VIII: 110 (1935).

Frutex 0.5-3 m altus e basi ramosus, ramulis junioribus dense cinnamomeo-tomentosis. *Folia* stipulata petiolata, stipulis lineari-subulatis 5-7 mm longis caducis, petiolo 7-15 mm longo, lamina basi late cordata vel subcordata vel rotundata profunde bilobata, lobis 1/4-1/2 longitudinis connatis oblique lato-ovatis vel elliptico-oblongis 3-7 × 1.5-4 cm, apice rotundatis vel obtusis 3-nerviis supra glabrescentibus conspicue reticulatis subtus cinnamomeo-pubescentibus nervis prominentibus. *Inflorescentia* ebracteata racemosa oppositifolia vel terminalis dense cinnamomeo-tomentosa saepissime 3-flora, pedunculo usque 3 cm longo, pedicellis 2-5 mm longis, bracteolis lineari-subulatis caducis 3-5 mm longis. *Alabastra* claviformia 6-7 cm longa. *Flores* magni ad 10 cm longi, calycis tubo cylindrico striato 2.5-3.5 cm longo. *Sepala* coalescentia apiculato-subulata, apiculo 3-5 mm longo, sub anthesin spathiformia. *Petala* unguiculata, ungue abrupte angustato 5-12 mm longo, pilis turgido-hyalinis sparse vestita, lamina elliptica vel ovato-elliptica margine crispo-denticulata, 4-5 × 2-3.5 cm, in unguem breviter decurrente. *Stamina* fertilia libera 5, 3 longiora cum 2 minora alternantia, filamentis basin versus hirsutis, antheris linearibus 5-8 mm longis, sterilia in phalangem liguliformem connata ananthera vel nonnunquam antheris abortivis instructa. *Ovarium* densissime hirsutum pluri-ovulatum longe stipitatum, stipite calycis tubo in toto longitudine adnato, parte libera 10-18 mm longa, stylo ovario aequilongo vel duplo longiore, stigmate discoideo. *Legumen* stipitatum lignosum ad 12-18 × 2-2.5 cm, basi oblique cuneatum apice attenuatum, juventute dense cinnamomeo-velutinum demum sparse pilosum,

stipite 1-2 cm longo; semina orbicularia vel obovato-orbicularia discoidea, ± 14×12 mm.

Lunda: entre Vila Henrique de Carvalho e Dala, rio Luachimo, alt. 1300 m, *Exell & Mendonça* 1017 (BM; Coi); Dala, Biula, rio Chigi, *Exell & Mendonça* 1188 (BM; Coi); Luma-Cassai, alt. c. 1250 m, *Exell & Mendonça* 1225 (BM; Coi).

Benguela: Nova Lisboa, Chitende, *Andrada* 24 (Lis. C).

Bié: entre os rios Cutato e Cuchi, *Gossweiler* 2223 (BM; Coi; K); entre Vila Serpa Pinto e a Missão de Chibomba, *Gossweiler* 2448 (BM; Coi; K).

Moxico: Vila Luso, *Carrisso & Mendonça* 577 (BM; Coi); Vila Luso, alt. c. 1300 m, *Exell & Mendonça* 1629 (BM, tipo; Coi); Vila Luso, *Gossweiler* 11173 (Coi); Vila Luso, rio Luena, *Young* 297 (BM), 323 (BM), 1330 (BM).

Bauhimia Mendoncae relaciona-se com *B. macrantha* Oliv., da qual difere pelo indumento cinamómeo-tomentoso e ovário densamente tomentoso.

[A. R. T. & D. H.]

Adenolobus (Harv.) Torre & Hillcoat, gen. nov. (Leguminosae).

Bauhinia Sect. *Adenolobus* Harv. in Harv. & Sond., Fl. Cap. II: 275 (1862). — Benth. in Benth. & Hook. f., Gen. Pl. I: 576 (1865).

Espécie típica: **Adenolobus garipensis** (E. Mey.) Torre & Hillcoat, comb. nov. = *Bauhinia garipensis* E. Mey., Comment. Pl. Afr. Austr. I: 162, (1836).

Adenolobus mossamedensis Torre & Hillcoat, sp. nov. Tab. III.

Suffrutex divaricato-ramosus usque 50 cm altus, glaberrimus, ramulis primo laevibus, pruinosis, glandulis stipitatis sparsis 1.5-2 mm longis instructis. *Folia* integra vel late emarginata basi subcordata 3-5-nervia, transverse elliptica, petiolata, petiolo 5-10 mm longo, lamina 8-23×10-26 mm. *Flores* in racemos axillares vel oppositifolios 10-25 cm longos laxos multifloros, glandulis sparsis stipitatis instructis, dispositi, bracteis bracteolisque scarioso-hyalinis ovato-lanceolatis mox caducis, pedicellis

3-5 mm longis. *Receptaculum* subturbinatum c. 1 mm longum. *Calyx* 5 mm longus 5-dentatus, dentibus c. 1 mm longis. *Petala* 5, longe unguiculata oblongo-lanceolata, c. 18×3 mm, lutea fusco-rubropunctata. *Stamina* 10 libera quam petala longiora. *Ovarium* longe stipitatum oblongum, glandulis 3-4 sutura ventrali ortis, stylo filiformi c. 10 mm longo, ovulis pluribus. *Legumen* semilunatum ensiforme stipitatum, stipite c. 10 mm longo, planum eglandulosum, valvulis membranaceis, c. 20×12 mm; semina plura.

Moçâmedes: deserto de Moçâmedes, vale do Coroca, *Carrisso & Sousa* 237 (BM; Coi); rio Coroca, próx. de Porto Alexandre, alt. 70 m, *Gossweiler* 12796 (Lis. C, tipo).

Esta espécie difere de *Adenolobus Pechuelii* (Kuntze) Torre & Hillcoat (1) pela ausência de glândulas sésseis no cálice, ovário e vagens.

[A. R. T. & D. H.]

Gigasiphon Gossweileri (Bak. f.) Torre & Hillcoat, comb. nov. (Leguminosae).

Bauhinia Gossweileri Bak. f. in Journ. of Bot. LXVI, Suppl. Polypet.: 139 (1928).

Cabinda: Maiombe, Pango Munga, *Gossweiler* 6124 (BM, tipo; Coi; Lis. U).

[A. R. T. & D. H.]

Tylosema (Schweinf.) Torre & Hillcoat, gen. nov. (Leguminosae).

Bauhinia Sect. *Tylosema* Schweinf., Reliq. Kotsch.: 17 (1868).

Espécie típica: **Tylosema fassoglensis** (Kotschy) Torre & Hillcoat, comb. nov. = *Bauhinia fassoglensis* Kotschy in Schweinf., *op. cit.*: 14, t. 12, 13 (1868).

[A. R. T. & D. H.]

(1) **Adenolobus Pechuelii** (Kuntze) Torre & Hillcoat, comb. nov. = *Bauhinia Pechuelii* Kuntze in Jahrb. Königl. Bot. Gart. Berl. IV: 263 (1886).

Anthonotha Noldeae (Rossberg) Exell & Hillcoat, comb. nov. (Leguminosae).

Macrolobium Noldeae Rossberg in Fedde, Repert. XXXIX: 156 (1936). — J. Léonard in Fl. Cong. Belg. et Ruanda-Urundi III: 419 (1952).

Malange: Quela, *I. Nolde* 213 (BM, isotipo).

Louis (Ess. forest. et Bois Cong. fasc. 6, Publ. Ineac: 13, 1949) e R. Cowan (Mem. N. Y. Bot. Gard. VIII: 258, 1953) já sugeriram a separação das espécies africanas de *Macrolobium*, restringindo este género às espécies americanas. Estes autores, porém, não fizeram qualquer transferência. Não achando suficientes os argumentos então enunciados, J. Léonard *(loc. cit.)* mantinha o género *Macrolobium* na ideia de incluir neste várias espécies africanas; mas, depois de encontrar diversos argumentos novos para a separação das espécies africanas, chegou à conclusão que o antigo género *Anthonotha* devia ser restabelecido. Concordamos com esta opinião e transferimos três espécies angolanas para *Anthonotha*. Uma outra espécie, *Macrolobium coeruleum* (Taub.) Harms, será pròximamente descrita por Léonard em género novo. Antecipamos aqui a obra do Dr. Léonard, aliás com a sua plena concordância, tendo em vistas a próxima publicação das *Caesalpinioideae* no «Conspectus Florae Angolensis».

[A. W. E. & D. H.]

Anthonotha fragrans (Bak. f.) Exell & Hillcoat, comb. nov.

Macrolobium fragrans Bak. f. in Journ. of Bot. LXVI, Suppl. Polypet.: 140 (1928); Legum. Trop. Afr.: 673 (1930). — J. Léonard in Fl. Cong. Belg. et Ruanda-Urundi III: 419, fig. 34, E (1952).

Cabinda: Maiombe, Belize, *Gossweiler* 7577 (BM, tipo; Br; Coi; K; Lis. U).

[A. W. E. & D. H.]

Anthonotha Pynaertii (De Wild.) Exell & Hillcoat, comb. nov.

Macrolobium Pynaertii De Wild. in Ann. Mus. Cong. Belg. Sér. 5, III: 192 (1910). — Bak. f. in Journ. of Bot. LXVI, Suppl. Polypet.: 139 (1928). — J. Léonard in Fl. Cong. Belg. et Ruanda-Urundi III: 411, fig. 34, H-I (1952).

Macrolobium Palisoti Benth. in Trans. Linn. Soc. Lond. XXV: 308 (1865) pro parte quoad specim. Welw. cit. — Oliv., Fl. Trop. Afr. II: 297 (1871) pro parte quoad specim. Welw.

Vouapa macropylla sensu Hiern, Cat. Afr. Pl. Welw. I: 299 (1896).

Macrolobium macrophyllum sensu Bak. f. in Journ. of Bot. LXVI, Suppl. Polypet.: 139 (1928) pro parte excl. specim. Gossw. 751.

Cabinda: Maiombe, *Dawe* 227 (K); rio Chiluango, *Gossweiler* 5858 (K); Maiombe, rio Munze, Buco Zau, *Gossweiler* 6673 (BM; Coi; Lis. U), 6673b (BM, col. carp.); Seva, Sub-Luali, *Gossweiler* 8029 (BM; Coi; K; Lis. U).

Cuanza Norte: Cazengo, Granja de S. Luís, margens do rio Mumbeje, *Gossweiler* 4510 (BM; Coi; K; Lis. U), 4725 (BM; Coi), 5221 (BM; Coi; K; Lis. U); Golungo Alto, Sobado de Bumba e Serra de Alta Queta, *Welwitsch* 560 (BM; Coi; K; Lis. U).

[A. W. E. & D. H.]

Berlinia Bruneelii (De Wild.) Torre & Hillcoat, sp. nov. (Leguminosae).

Berlinia acuminata var. *Bruneelii* De Wild. in Ann. Mus. Cong. Belg. Bot. Sér. 5, II: 138 (1907).

Berlinia grandiflora var. *Bruneelii* (De Wild.) Hauman in Fl. Cong. Belg. et Ruanda-Urundi III: 393 (1952).

Lunda: Vila Henrique de Carvalho, rio Chicapa, *Carrisso & Mendonça* 450 (BM; Coi); Vila Henrique de Carvalho, alt. 1100 m, *Exell & Mendonça* 942 (BM; Coi), 943 (BM; Coi), 957 (BM; Coi).

Consideramos este taxon como especificamente distinto.

[A. R. T. & D. H.]

Berlinia lundensis Torre & Hillcoat, sp. nov. Tab. IV.

Arbor c. 8 m alta, ramulis fulvo-tomentellis. *Folia* paripinnata petiolata, petiolo 2-3 cm longo, rhachide fulvo-tomentella 6-7 cm longa, foliolis 3-jugatis chartaceis, proximalibus minoribus oblique ovatis vel ovato-lanceolatis, distalibus majoribus oblique oblongo-ellipticis basi rotundatis vel obtusis vel nonnunquam cordulatis, supra glabris subtus sparse pubescentibus demum glabrescentibus, nervis lateralibus utrinsecus 7-9 subtus conspicuis, lamina 7-15 × 3-7 cm, petiolulo 3-5 mm longo. *Flores* albi pedicellati, pedicello 2.4-4.5 cm longo fulvo-tomentello bracteato, bracteis lanceolatis 10 × 5 mm fulvo-velutinis, bracteolis obovato-oblongis 3.5-4 × 1.3-1.5 cm extus fulvo-velutinis intus tomentosis medio longitudinaliter cristatis, in paniculas 15-20 cm longas breviter pedunculatas fulvo-pubescentes terminales vel subterminales ad apices ramulorum vel nonnunquam in axillis foliorum superiorum dispositi. *Calycis tubus* subcylindricus c. 1.5 cm longus extra velutino-tomentosus, lobis angustato-elongatis c. 1.5 cm longis extra tomentosis. *Petala* 5, 1 posterius magnum unguiculatum suborbiculare margine crispum ± 4 × 4 cm pubescens basin versus tomentosum, 4 minora ligulata usque 1 cm longa. *Stamina* 9 + 1, filamentis basin versus pilosis. *Ovarium* fusiforme stipitatum, ± 6-ovulatum, tomentosum, stylo filiformi 2-3 cm longo glabro, stigmate parvo terminali. *Legumen* ambitu oblanceolatum (immaturum 19 × 5.5 cm), stipitatum, fusco-tomentosum; semina applanato-suborbicularia 3--3.5 cm in diam., glabra.

Lunda: Dundo, rio Luachimo, alt. 700 m, *Gossweiler* 13745 (K, tipo: Lis. C; Lua).

Esta espécie difere de *Berlinia Craibiana* Bak. f. por ter as bractéolas oblongo-elípticas ou subobovadas e costadas, indumento seríceo-tomentelo e pétala posterior menor.

Gossweiler notifica que as sementes foram colhidas de vagens do ano anterior encontradas no chão.

[A. R. T. & D. H.]

Amblygonocarpus andongensis (Welw. ex Oliv.) Exell & Torre, comb. nov. (Leguminosae).

Tetrapleura andongensis Welw. ex Oliv., Fl. Trop. Afr. II: 331 (1871).

[A. W. E. & A. R. T.]

Albizia mossamedensis Torre, sp. nov. (Leguminosae). Tab. V.

Arbor c. 12 m alta, ramulis mox glabrescentibus. *Folia* bipinnata stipulata, stipulis caducis, pinnis 5-6-jugatis 5-10 cm longis, foliolis 7-10-jugatis sessilibus, lamina oblique rhomboidea, apice rotundata vel truncata nonnunquam mucronulata, 8-22 × × 5-10 mm, margine minute ciliolata ceteroque glabra, basi glandula transverse elliptica 1 × 0.5 mm instructa, haud auriculata, rhachide minute puberula glandulis parvis suborbicularibus infra foliorum juga ortis. *Flores* sessiles in capitula multiflora paniculata pedunculata, pedunculo 2-2.5 cm longo puberulo, dispositi. *Calyx* subcylindricus 3.5-4 mm longus, minute puberulus, apice brevissime dentatus. *Corolla* cylindrica, 8-10 mm longa puberula apice cupuliformis irregulariter 5-lobata, lobis 1-1.5 mm longis. *Tubus staminalis* ± 10 mm longus, filamentorum partibus liberis 2-3 mm longis atro-purpureis. *Ovarium* fusiforme 2 mm longum glabrum, stylo filiformi ± 12 mm longo. *Legumen* sinuato-oblongum, 10-12 × 2-2.5 cm, glabrum, valvis papyraceis, seminibus ± 6 late depresse-ellipsoideis nitidulis.

Moçâmedes: Vila Arriaga, ravinas de Maite, alt. 1000 m, *Gossweiler* 12801 (Lis. C, tipo).

Esta espécie relaciona-se com *A. intermedia* De Wild. & Dur. da qual difere pela nervação dos foliolos, inflorescências mais congestas, e tubo estaminal mais curto.

[A. R. T.]

Drosera elongata Exell & Laundon, sp. nov. (Droseraceae). Tab. VI.

Caulis elongatus leviter flexuosus 60-90 cm longus, usque 1 mm in diam., in toto longitudinis foliatus appresse-pilosulus.

Folia apicem caulis versus adscendentia mox horizontalia demum deflexa, stipulata, stipulis scariosis c. 3 mm longis alte incisis, petiolata, petiolo 1-1.5 cm longo pubescente, lamina obovata vel late elliptica 3-6 × 2-3 mm supra marginem versus tentaculis glanduligeris rufis 4 mm longis munita, subtus appresse-pilosula. *Flores* purpureo-rosei pedicellati, pedicello 1-4 mm longo pubescente, in racemos unilaterales pedunculatos, pedunculo scapiformi solitario 10-25 cm longo, bracteatos, bracteis linearibus 2-4 mm longis pubescentibus, dispositi. *Sepala* 5, elliptica basi connata apice obtusa vel acuta 3-4 × 1 mm, extus glanduloso-pubescentia intus glabra. *Petala* 5 obovata, 5×2 mm, glabra membranacea. *Stamina* 5, filamentis 4 mm longis. *Ovarium* ellipsoideum, 1.5 × 1 mm, glabrum, stylis 3 ad basin bipartitis, 2-3 mm longis. *Semina* fusiformia, 0.6 × 0.2 mm, nigra nitida glabra.

Lunda: Luma-Cassai, alt. c. 1250 m, *Exell & Mendonça* 1268 (BM, type; Coi).

This species belongs to Subg. *Drosera*, Sect. *Drosera*, Ser. *Eurossolis* Diels (formerly Subg. *Rorella* DC., Sect. *Rossolis* Planch., Ser. *Eurossolis* Diels). It differs from the closely related species *D. flexicaulis* Welw., *D. glabripes* (Harv.) Salter, *D. katangensis* Taton, *D. madascariensis* DC. and *D. ramentacea* Burch. ex DC. in the great length of the stem (up to 90 cm), which rarely exceeds 25 cm in the other species, the even spacing of the leaves and the fact that the petioles are typically at right angles to the stems. Moreover, the leaf-blades are obovate to broadly elliptic rather than more or less spathulate as in the other species.

D. elongata was found growing in the « tengas » or marshes which occur along the slopes of most of the river-valleys in Lunda, in association with *Dissotis gracilis* Cogn., *Dicoma anomala* var. *megacephala* (Bak.) Mendonça, *Emilia Baumii* (O. Hoffm.) S. Moore and various species of *Xyris*, *Eriocaulon* and *Utricularia* and *Gramineae*. In this dense community several species of both *Utricularia* and *Drosera* have adopted an elongated habit with long wiry stems which often twine round the grass-haulms.

[A. W. E. & J. R. L.]

Drosera compacta Exell & Laundon, sp. nov. (Droseraceae). Tab. VII.

Caulis 4-6 cm longus dense piloso-pubescens in toto longitudinis dense foliatus. *Folia* spiraliter aggregata apicem caulis versus adscendentia basin eius versus deflexa vel horizontalia, stipulata, stipulis lineari-lanceolatis ± laciniatis, 2 mm longis, petiolata, petiolo 5-10 mm longo dense piloso, laminas pathulata 4-6 × 3-5 mm, basi cuneata, margine tentaculis glanduligeris ferrugineis munita, subtus appresse-cinereo-pilosa. *Flores* pedicellati, pedicello glanduloso-pubescente 1-4 mm longo, in racemos 4-10-floros unilaterales pedunculatos, pedunculo scapiformi 7-13 cm longo erecto, apicem versus glanduloso-pubescente basin versus pilosulo, bracteatos, bracteis linearibus 2-3 mm longis, dispositi. *Sepala* 5, elliptica, 4 × 2 mm, basi connata, apice irregulariter serrulata, basin versus extra glanduloso-pubescentia. *Petala* rosea, 7 mm longa, glabra. *Stamina* 5, filamentis 4 mm longis. *Ovarium* ellipsoideum, 2 × 1.5 mm, glabrum, stylis 3 ad basin bipartitis. *Semina* minuta applanato-subglobosa.

Lunda: R. Luachimo, alt. c. 1300 m, *Exell & Mendonça* 1030 (BM, type; Coi).

This species also belongs to the typical subgenus, section and series. It is characterized by the compact arrangement of the leaves up the whole length of the stem and is related to *D. Bequaertii* Taton from the Belgian Congo, which also has mainly ascending leaves and straight peduncle, but the leaves in the latter species are far fewer and much more widely spaced on the stem and the hairs beneath the lamina are reddish rather than grey. The inflorescence in *D. compacta* is more densely glandular-pubescent.

The new species was found growing in a similar habitat to that of the preceding one *(D. elongata)*. It was associated with *Sphagnum* spp., *Polygala Claessensii* Chod., *Dissotis longicaudata* Cogn., *Thesium* sp., *Xyris* spp., *Eriocaulon* sp. and various *Gramineae* and *Cyperaceae*.

We are grateful to the Director of the Jardin Botanique de l'Etat, Brussels, for lending us the types of species of *Drosera* recently described from the Belgian Congo by Taton.

[A. W. E. & J. R. L.]

LEGENDA DAS TABULAS

TABULA I

A — **Cassia africana** (Steyaert) Mendonça & Torre

(a) Estípula e glândula peciolar (×8); (b) Folíolo (×8); (c) Flor (×4). *Anchieta* 82.

B — **Cassia Fenarolii** Mendonça & Torre

(a) Estípula e glândula peciolar (×8); (b) Folíolo (×8); (c) Flor (×4). *Fenaroli* 1108 a.

C — **Cassia biensis** (Steyaert) Mendonça & Torre

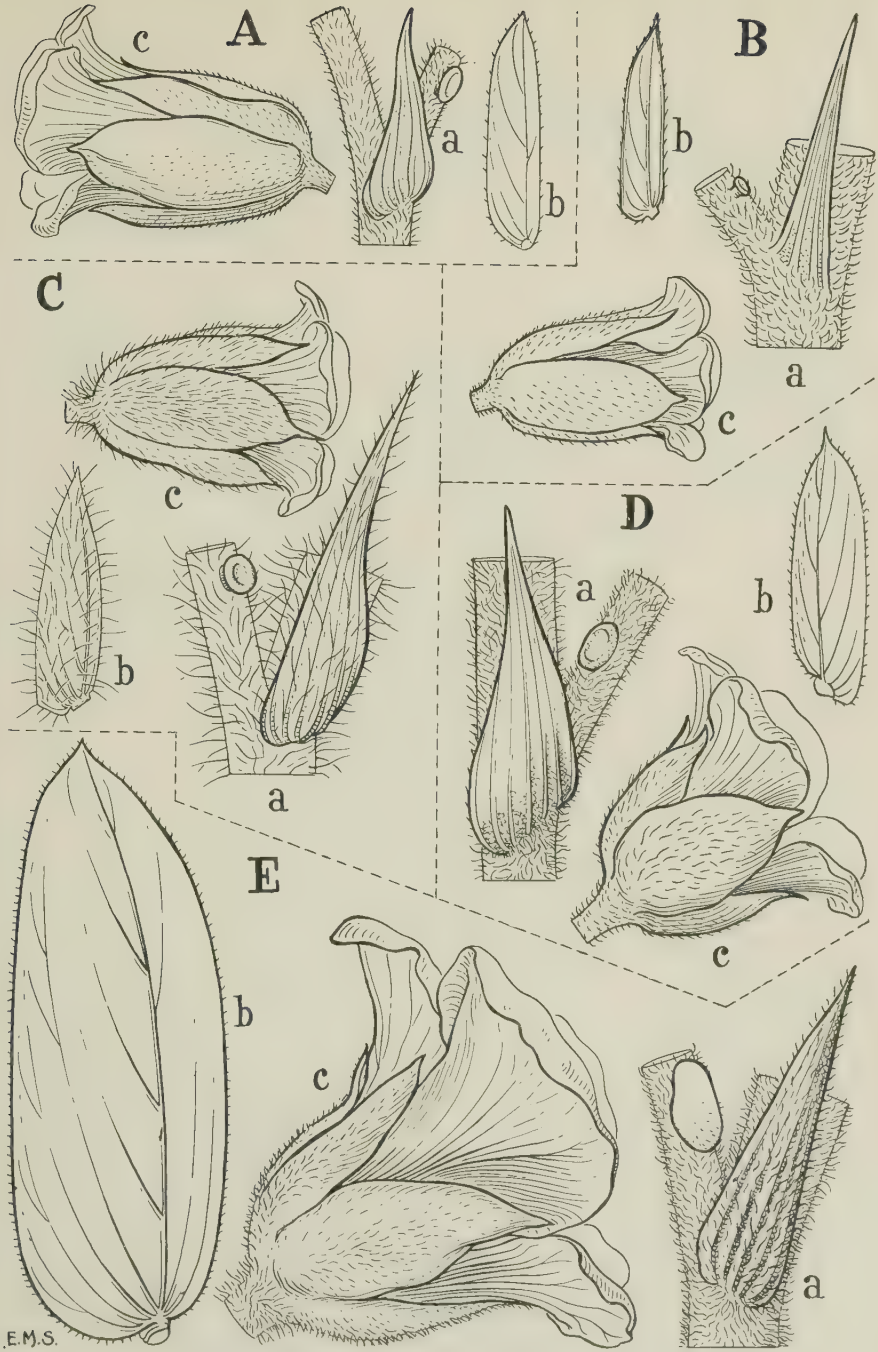
(a) Estípula e glândula peciolar (×8); (b) Folíolo (×8); (c) Flor (×4). *Fenaroli* 1336.

D — **Cassia Newtonii** Mendonça & Torre

(a) Estípula e glândula peciolar (×8); (b) Folíolo (×8); (c) Flor (×4). *Newton* 98.

E — **Cassia huillensis** Welw. ex Mendonça & Torre

(a) Estípula e glândula peciolar (×8); (b) Folíolo (×8); (c) Flor (×4). *Welwitsch.* 1721.



A — **Cassia africana** (Steyaert) Mendonça & Torre
B — **Cassia Fenarolii** Mendonça & Torre
C — **Cassia biensis** (Steyaert) Mendonça & Torre
D — **Cassia Newtonii** Mendonça & Torre
E — **Cassia huillensis** Welw. ex Mendonça & Torre

TABULA II

Bauhinia Exellii Torre & Hillcoat

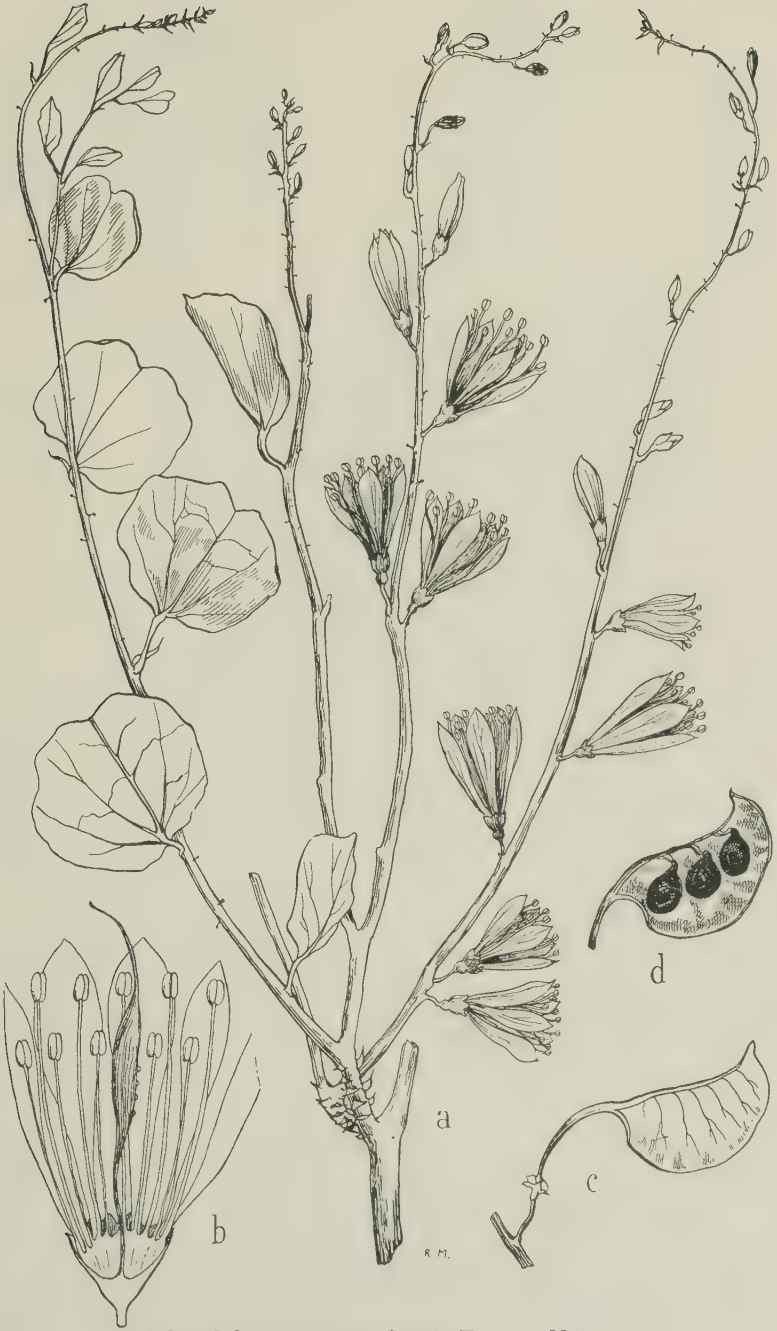
(a) Ramo florífero (× 1/2); (b) Secção vertical da flor (× 1); (c) Vagem (× 1/2); (d) em deiscência (× 1/2). a-b, *Exell & Mendonça* 1461; c-d. *Gossweiler* 11198 b.

Bauhinia Exellii Torre & Hillcoat

TABULA III

Adenolobus mossamedensis Torre & Hillcoat

(a) Ramos floríferos (×1); (b) Secção vertical da flor (×2); (c) Vagem (×1); (d) Vagem aberta (×1). a-b, *Gossweiler* 12796; c-d, *Carrisso & Sousa* 273.



Adenolobus mossamedensis Torre & Hillcoat

TABULA IV

Berlinia lundensis Torre & Hillcoat

(a) Ramo florífero ($\times 1/2$); (b) Bractéola ($\times 1$); (c) Flor ($\times 1$); (d) Secção vertical da flor ($\times 2$); (e) Sépala ($\times 1$); (f) Pétala ($\times 1$); (g) Estandarte; (h) Tubo estaminal aberto planificado ($\times 1$); (i) Ovário e estilete ($\times 1$); (j) Vagem (imatura) ($\times 1/2$); (k) Semente ($\times 2/3$). *Gossweiler* 13745.

Berlinia lundensis Torre & Hillcoat

TABULA V

Albizia mossamedensis Torre

(a) Ramo florífero (×2/3); (b) Par de folíolos (×1 1/2); (c) Flor (×6); (d) Cálice planificado (×6); (e) Corola planificada (×6); (f) Tubo estaminal (×6); (g) Antera (×30); (h) Ovário e estilete (×6); (i) Vagem (×2/3); (j) Semente (×2). *Gossweiler* 12801.

Albizia mossamedensis Torre

Drosera elongata Exell & Laundon

Drosera compacta Exell & Laundon

MELASTOMATACEAE AFRICANAE NOVAE VEL MINUS COGNITAE — II.

AUCTORIBUS

A. FERNANDES et ROSETTE FERNANDES

Instituti Botanici Universitatis Conimbrigensis

Tristemma rubens sp. nov. (Tab. I)

Tristemma sp. Exell in Journ. of Bot. **67**, Suppl. Polypet.: 181 (1929).

Suffrutex usque ad 1 m altus. *Rami* tetragoni, cortice brunneo-rufescenti obtecti, dense longeque setosi, setis rubris, subpatulis, ad nodos annulo setarum validiorum et longiorum ornati. *Folia* 5-nervia, membranacea, elliptica, 6,5-17 × 3-7 cm, apice acuminata, acutissima, basi cuneata in petiolum 1-3 cm longum, densissime setosum, setis patulis rubris usque 7 mm longis, sensim attenuata; lamina utrinque densiuscule et longiuscule subadpresse strigosa, ad nervos setis validioribus ornata. *Flores* in capitula breviter pedunculata, 2-5-flora (in speciminibus visis) dispositi; bracteae exteriores foliaceae, usque 2,5 × × 0,6 cm, utrinque dense rubro-setosae; bracteae interiores membranaceae, late orbiculato-ovatae vel ovato-lanceolatae, obtusae vel in acumen plus minusve contractae, dorso dense longeque adpresse rubro-setosae. *Receptaculum fructiferum* 11 × 7-8 mm, setis usque 5,5 mm longis, rubris, nitentibus, 3 annulos (inferiorem plerumque interruptum) formantibus, supra medium ornatum. *Calycis lobi* triangulares, 6 × 3 mm, ad marginem ciliati, apice setosi, caeteris glabri, acuti. *Capsula* in apice setis longis, rubris dense munita. *Semina* aurantiaca, circ. 0,4 mm, papillis minutissimis in lineis curvatis dispositis ornata. *Petala* et *stamina* non vidimus.

Fr.: Mart.

Habitat in Angola, regione Cabinda, loco dicto *Belize* ad margines fluminis *Nzanza-Lufo*, 1-III-1919, *Gossweiler* 7866 (BM; COI, typus; LISJC; LISU).

«Erva vivaz atingindo 1 m de altura, felpuda; pêlos vermelho-acastanhados. Disseminada pela floresta Pluviisilva da cataracta do rio Nzanza-Lufo, Belize, Alto Maiombe».

Affinis T. hirto P. Beauv. a quo setis rubris nec albidis, foliis ellipticis, longioribus, basi longe cuneatis nec ovato--oblongis basi rotundatis, etc. differt.

Melastomastrum Schlechteri sp. nov. (Tab. II)

Tristemma Schlechteri Gilg in Schlechter Westafr. Kautschuk-Exped.: 302 nom. nud.

Frutex? Rami tetragoni ad angulos anguste alati, longitudinaliter striati, brevissime adpresseque setosi, setis basi bulbosis; internodia 2,7-4,5 cm longa quam folia multo breviora. *Folia* membranacea usque ad 2 cm longe petiolata, petiolo basi dilatato, supra leviter canaliculato, setis eisdem caulium similibus densissime obtecto; lamina oblongo-lanceolata, 8-16,5 × 2,7-5 cm, basi leviter cuneata, apice acuminata, acutiuscula, margine integra, 5-nervia, nervis supra impressis subtus prominentibus, venis transversalibus numerosis, costae subrectangulo-impositis, utrinque conspicuis; pagina superior glabrescens, inferior sub lente subtiliter strigillosa ad nervos brevissime adpresseque setulosa. *Flores* 5-meri, subsessiles, solitarii vel gemini, terminales et in axillis foliorum superiorum dispositi, bracteis persistentibus inclusi. *Bracteae* exteriores lanceolatae, usque 12 × 3 mm, dorso adpresse setulosae, margine scariosae; interiores scariosae, breviores et latiores usque latissime obovatae, obtusae, glabrae vel ad dorsum plus minusve anguste adpresse setosae. *Calycis tubus* in alabastro ante anthesin subcylindricus, 9 × 6 mm, basi setis albidis brevibus adpressis ornatus, caeteris glaberrimus; lobi ovato-lanceolati, acuminati, margine ciliati, 7 × 4 mm. *Stamina* non evoluta in alabastro inclusa 10 valde inaequalia; antherae majores 7 mm longae, pedoconnectivo circ. 2 mm longo, ad basim antice biappendiculato, appendicibus circ. 1 mm longis, postice

minute bituberculato; filamentum 3 mm longum; antherae minores 6 mm longae, pedoconnectivo brevissimo circ. 0,5 mm longo ad basim antice biappendiculato, appendicibus circ. 1 mm longis, postice calcarato. *Ovarium* circ. 6 × 3 mm, basi styli annulo multisetoso circumdata. *Receptaculum fructiferum* 14 × × 7 mm.

Fl. et fr.: Oct.

Habitat in Africa Occidentali, loco dicto *Ngoka*, X-1899, *Schlechter* 12782 (BR; K; P; PRE, typus).

Specimen in Museo Bruxellensi visum florem apertum et stamina evoluta ostendebat.

Affinis M. segregato (Benth.) A. et R. Fernandes a quo ramis acute tetragonis anguste alatis nec obtuse tetragonis, foliis glabrescentibus, longioribus et latioribus, lanceolatis nec ovato-lanceolatis, setis omnium partium brevioribus, etc. differt.

Dissotis debilis (Sond.) Triana var. **lanceolata** (Cogn.) A. et R. Fernandes comb. nov. (Tab. III)

Dissotis lanceolata Cogn. in A. et C. DC. Monogr. Phan. **7**: 366 (1891). — Hiern, Cat. Afr. Pl. Welw. **1** (2): 366 (1898). — De Wild. et Th. Dur. in Bull. Herb. Boiss. sér. 2, **1**: 22 (1900). — De Wild. in Ann. Mus. Congo, Bot. sér. 5, **3**: 224 (1910).

forma **lanceolata**

ANGOLA — CUANZA BOREALIS: *Pungo Andongo, Mechow* 37 (BR); *Pungo Andongo*, ad margines fluminis *Luxilo*, alt. 720-1150 m, *Welwitsch* 910 (BM; BR; COI; K; LISU; P); *Pungo Andongo*, ad margines fluminis *Cuanza*, *Welwitsch* 910 b (BM; LISU); *Pungo Andongo*, pr. *Condo*, *Welwitsch* 910 c (BM; LISU); *Pungo Andongo*, pr. *Quissonde*, *Welwitsch* 910 d (BM; LISU). MALANGE: inter *Malange* et flumen *Cuanza*, alt. 1200 m, *Exell et Mendonça* 127 (BM; COI; LISJC); pr. locum dictum *Quizanza*, *Gossweiler* 1273 (K; P). LUNDA: *Dala*, flumen *Chiumbe*, alt. 1150 m, *Gossweiler* 11239 (COI; LISJC). BENGUELLA: *Alto Catumbela, Ganda, Mumbassoco*, alt. 1350 m, *Faulkner* 159 (COI; PRE). BIÉ: *Menongue, Domba-Cuanaval*, pr. flumen *Cuana-*

val-Cuito, alt. 1200 m, *Gossweiler* 2671 (BM; COI; K; LISJC); ad margines fluminis *Cuchi*, alt. c. 1200 m, *M. A. Pocock* 326 (PRE). MOXICO: pr. flumen *Luova*, *Milne-Redhead* 4172 (K).

CONGO BELGICA — *Elisabethville* ad margines fluminis, *Quarré* 5394/B (PRE).

RHODESIA BOREALIS — pr. *Kassana*, inter *Luhona* et *Zinda*, *M. A. Pocock* 228 (PRE).

NIASSALANDIA — s. l., *Smuts* 2257 (PRE).

AFRICA AUSTRO-OCCIDENTALIS — *Waterberg Plateau*, *G. Boss* s. n. (numerus 35029 Herbarii Transvaalensis Musei) (PRE); *Oshikango*, alt. c. 1050 m, *E. M. Loeb* 16 et 216 (PRE).

forma **subisandra** nov. forma

A typo staminibus subaequalibus differt.

Habitat in Angola, regione *Malange*, loco dicto *Quizanza* pr. *Cazengo*, *Almeida* s. n. (LISJC, typus); *Quizanza*, *Gossweiler* 1273 pro parte (BM).

Dissotis rupicola Gilg ex Engl. (Tab. IV et V)

Descriptio Cl. Engl. in Engl. et Drude, Veg. Erde IX, Pflanzenw. Afr. 3 (2): 748 (1921) sic amplificanda est:

Herba perennis, basi lignosa. *Caules* usque ad 40 cm longi (probabiliter ultra), procumbentes, radicantes, partibus vetustioribus defoliatis; rami erecti vel adscendentes, usque 10 cm alti; rami et caules tetragoni, ad angulos anguste alati et sparse setoso-glandulosi, setis adscendentibus, caeteris glabri, ad nodos longiuscule setosi, cortice fulvo-purpurascenti obtecti. *Folia* parva, usque 2,6 × 1 cm, generaliter minora, oblongo-elliptica vel oblongo-lanceolata, membranacea, discoloria, supra (in sicco) obscure-viridia, infra albida, subsessilia vel in petiolum brevem abrupte contracta, obtusiuscula, subtiliter crenulata, crenulis seta brevi antrorsa munitis, 3-nervia, nervis lateralibus tenuissimis apicem vix attingentibus, glabra (nervo mediano inferne sparse setoso). *Cymae* valde laxae, 2-4-florae (rare flores solitarii). *Flores* 4-meri (vel etiam 5-meri?), breviter

pedicellati, pedicellis 1,5-3 mm longis, sparse setoso-glandulosis, bracteati, bracteis foliis similibus sed minoribus. *Calycis tubus* campanulatus, 6 × 4 mm, glaber; lobi lanceolati, 8 × 2,5 mm, glabri vel sparsissime setoso-glandulosi, in apicem acutum seta ornati, marginibus ciliati, cum dentibus simplicibus, setaceis, brevibus (2 mm) alternantes. *Petala* pallide rosea, 1 cm longa. *Stamina* valde inaequalia; antherae verticilli exterioris circ. 6,5 mm longae, pedoconnectivo 3,5 mm longo, basi appendice simplici linguiformi 2 mm longo munito; filamentum 5 mm longum; antherae verticilli interioris 4,5 mm longae, pedoconnectivo 1,2 mm longo in tuberculum minimum bilobatum terminato; filamentum 6 mm longum. *Ovarium* 4,5 × 3 mm, apice glabrum; stylus 10 mm longus in alabastris fere apertis. *Receptaculum fructiferum* ovoideum, turgidum, faciliter longitudinaliter ruptum, lobis calycis coronatum. *Semina* circ. 2 mm, verruculosa.

Fl. et fr.: Dec.

Habitat in Liberia, loco dicto *Sinoe*, alt. c. 20 m, 4-XII-1903, *M. Dinklage* 2139 (BD).

«Dem Felsen anliegend und halbaufsteigend mit roten Stengeln und etwas fleischigen, unter silbergrauen Blättern, Blüten hellrot; kahler schwarzer Felsen in der Flussmündung».

Affinis D. pygmeae A. Chev. et Jac.-Fél. a qua caulibus glabris ad angulos setoso-glandulosis nec longe flavescenti-pilosis, foliis minoribus, oblongo-ellipticis nec ovato-lanceolatis, receptaculo glabro neque pilis patentibus obtecto, seminibus verruculosis neque laevibus, etc. differt.

Dissotis arborescens sp. nov. (Tab. VI)

Arbuscula usque ad 6,5 m alta. *Rami* robusti, lignosi, obtuse tetragoni, profunde sulcati, valde nodosi, internodis 0,8-4 cm, primum brevissime adpresse denseque setulosi, setulis basi incrassatis, deinde glabri cortice cinereo longitudinaliter fisso obtecti, supra cicatrices foliorum delapsorum gemmulis densissime villosis ornati. *Folia* tempore florescentiae plerumque delapsa, 1-2,3 cm longe petiolata, petiolo crasso basi dilatato, dense setuloso; lamina chartacea, elliptica usque ovata, 4,5-9,5 × 2,3-6 cm, basi cuneata vel plus minusve rotundata, margine minute denticu-

lata, 5 (-7)-nervia, nervis supra impressis subtus prominulis, nervis transversis conjunctis ; pagina superior densissime et longiuscule setosa, setis supra papillas conicas insertis, inferior pallidior, foveolata, longiuscule villosa. *Flores* 5-meri, breviter pedicellati, ad apicem ramulorum dense aggregati. *Bracteae* caducae, rubescentes, lanceolatae usque late ovatae, circ. 1 × 0,75 cm, dorso adpresse denseque setulosae, margine anguste scariosa ciliolatae. *Calycis tubus* cupuliformis, 8 × 8 mm, setis albidis, simplicibus, leviter spinulosis, basi tantum dilatatis, plus minusve dense vestitus ; lobi persistentes, utrinque rubri et glabri, late ovati vel subquadrati, 7 × 6 mm, apice rotundati vel oblique truncati, apiculati, margine revoluta ciliolata ; dentes intersepalares nulli. *Petala* purpurea, 2,6 × 2,3 cm, obcordata, apice emarginata, margine ciliolata. *Stamina* 10 valde inaequalia ; antherae majores 11 mm longae, pedoconnectivo 14,5 mm longo, basi biappendiculato, appendicibus oblongis, obtusis, 2,5 mm longis, incurvis ; filamentum 12 mm longum ; antherae minores 9 mm longae, pedoconnectivo 1,5 mm longo, basi biappendiculato, appendicibus oblongis circ. 2,5 mm longis, sursum incurvis ; filamentum 9 mm longum. *Receptaculum fructiferum* subhemisphaericum, sepalis persistentibus reflexis coronatum. *Capsula* paulo exserta, apice setis albidis validis leviter spinulosis ornata. *Semina* cochleata, papillis minutissimis, in lineis curvatis dispositis ornata.

Fl. Jun. et fr. Oct.

Habitat in Tanganhica, Iringa distr., loco dicto *Sao Hill*, alt. c. 2100 m, 25-VI-1941, *Greenway* 6176 (EA, typus ; PRE).

« A purple flowered much branched small tree up to 20 ft. tall. Local amongst granite rocks with *Protea*, *Brachystegia*, *Faurea* in *Loudetia-Rhyncholectryum-Hyparrhenia* grassland on a brown sandy loam derived from granite ».

« Tanganyika Terr. On the Sao Highlands. Growing in grassveld ; tree of about 15 ft. with blue flowers ». 17-VI-1938, *Pole Evans & J. Erens* 796 (PRE) ».

« Tanganyika Terr. Shrub 4' (?), no leaves present. S. H. Province, Sao Hill, X-1950, *G. B. Wallace* 1321 (EA) ».

Affinis D. Melleri Hook. f. a qua inflorescentia confertiore non foliosa, floribus majoribus, calycis tubo setis simplicibus longiusculis dense vestito nec squamis bulbosis ramoso-pectinatis sparse ornato, etc. differt.

Dissotis Bussei Gilg ex Engl. (Tab. VII)

Descriptio Cl. Engl. in Engl. et Drude, Veg. Erde IX, Pflanzenw. Afr. **3** (2): 749 (1921) sic amplificanda est:

Arbuscula usque ad 5 m alta. *Rami* robusti, lignosi, sulcati, nodis incrassati; juniores obtuse tetragoni, internodiis abreviatis, cortice flavescenti setis brevibus basi incrassatis minute spinulosis densissime obtecto, nodis annulo setarum validiorum cinctis; rami vetustiores subtereti, cortice griseo, glabro vel glabrescenti, irregulariter fisso obtecti. *Folia* (tempore florescentiae plerumque delapsa) usque 3,5 cm longe petiolata, petiolo crasso, basi dilatato, late ovata, usque 15 × 12 cm, basi profunde cordata, apice obtusa, margine integra, viridia vel plus minusve rubescentia, 5-7-nervia, nervis basi valde incurvis, supra impressis subtus prominentibus, venis utrinque parce conspicuis; pagina superior dense setosa, setis simplicibus, albidis, validis, incurvis, super papillas conicas insertis; inferior densissime griseo-flavescenti-tomentosa, ad nervos, venas et etiam petiolum, setis eisdem caulium similibus sed longioribus onusta. *Cymae* umbelliformes usque 6 mm longe pedunculatae, pluriflorae, ad apicem ramulorum aggregatae, inflorescentias breves valde confertas formantes. *Flores* 5-meri, usque 6 mm longe pedicellati, pedicellis setosis. *Bracteae* caducae, circ. 4 mm longae, extus dense setosae, setis spinulosis. *Calycis tubus* cylindrico-campanulatus, 9 × 7 mm, setis brevibus, simplicibus, sursum incurvis, basi bulbosis, minute spinulosis dense ornatus; lobi persistentes, utrinque rubri, oblique deltoidei, 4,5 × 4 mm, extus dorso setosi, margine ciliati; dentes intersepalares nulli. *Petala* purpurea, late obovata, circ. 2,2 × 1,9 cm, margine ciliolata. *Stamina* 10 valde inaequalia; filamentum staminum majorum 12 mm longum; antherae rubrae, 11 mm longae, pedoconnectivo arcuato, 10 mm longo, basi antice biappendiculato, appendicibus circ. 2 mm longis, apice crassiusculis; filamentum

staminum minorum 10 mm longum; antherae flavae 10 mm longae, pedoconnectivo brevissimo circ. 1 mm longo, basi antice biappendiculato, appendicibus circ. 1,5 mm longis, apice dilatatis. *Ovarium* ovoideum, 8 × 5 mm, apice setosum; stylus 3 cm longus. *Receptaculum fructiferum* circ. 10 × 7 mm, lobis calycis revolutis coronatum. *Semina* cochlearia, papillis in lineis curvatis dispositis ornata.

Fl. et fr.: Jul.-Oct.

Habitat in Tanganhica, pr. locum dictum *Mlali*, alt. c. 2200 m, 14-VII-1950, *P. R. O. Bally* B 7899 (EA).

«Gnarled tree with spreading crown, flowering when not in leaf, flowers purple, leaves red and green, tree about 15 ft. high, bark light gray. Gneiss formation edge of grassland top of hill with *Combretaceae*».

Etiam in Dodoma Prov., pr. locum dictum *Mpwapwa*, alt. c. 1400-1750 m, 20-VIII-1930, *Greenway* 2442 (EA).

«A beautiful flowered small tree up to 15 ft. tall with stiff erect branches and bright magenta flowers. Growing in rocks and on steep mountain slopes in *Brachystegia-Combretum* open woodland. Fairly common but scattered».

Etiam in Kondoa distr., *Bereku Ridge*, *Salanga Hill*, alt. c. 1750, 15-X-1932, *B. D. Burtt* 4412 (EA).

Affinis D. arborescenti A. et R. Fernandes a qua setis ramorum praeconspicue spinulosis, foliis latioribus basi profunde cordatis, setis paginae superioris foliorum brevioribus, floribus minoribus longius pedicellatis, bracteis minoribus, setis calycis tubi valde brevioribus, distincte spinulosis et basi manifeste bulbosis, etc. differt.

Affinis etiam D. Melleri Hook. f. a qua foliis profunde cordatis, inflorescentiis non foliosis confertioribusque, setis calycis tubi brevioribus, simplicibus, sub lente conspicue spinulosis, nec squamis adpressis plus minusve ramoso-pectinatis, etc. differt.

Dissotis pulchra sp. nov. (Tab. VIII)

Suffrutex? Rami floriferi obtuse tetragoni, siccitate sulcati, setis basi incrassata plerumque divisa (cum pilis minusculis,

simplicibus, aurantiaceis intermixtis) scabri; internodia valde elongata circ. 12 cm, folia superantia; nodia annulo setarum validarum, setis usque 7 mm longis, cincta. *Folia* usque 2,5 cm longe petiolata, petiolo, basi dilatato, supra canaliculato setis longis dense obtecto, infra convexo squamis multifidis basi incrassatis scabro; lamina ovato-lanceolata, 8,5-10 ⁄ 2,2-3,7 cm, basi rotundata, apice acuminata, margine denticulata, denticulis setis antrorso-recurvis munitis, 7-nervia, nervis supra impressis subtus valde prominentibus venis transversis prominulis conjunctis; pagina superior papilloso-setosa (papillis subconicis eleganter dispositis, lineis albidis in setas simplices usque 2 mm longas convergentibus ornatis) et sparse furfuraceo-pilosa, pilis eisdem caulium similibus; pagina inferior foveolata, molliter villosa, pilis longis albidis cum pilis minutissimis aurantiacieis intermixtis, nervis longitudinalibus squamis multifidis basi incrassata dense obtectis. *Flores* 5-meri, breviter pedicellati, in cymas plurifloras, paniculas terminales cir. 30 cm longas formantes, dispositi. *Bracteae* caducae, usque 14 mm longae, rubescentes, ovatae, obtusae, extus densissime adpresse setulosae. *Calycis tubus* oblongo-cylindricus, 10 ⁄ 5 mm, setis albidis, 0,5-1,5 mm longis, basi tantum dilatata interdum divisa, densissime adpresseque obtectus; lobi oblongo-lanceolati, 11 ⁄ 4 mm, acuminati, carinati, apice obliquo, obtusiusculo, longiuscule setoso, extus setis eisdem calycis tubi similibus vestiti, intus glabri et purpurei, cum dentibus linearibus, 3 ⁄ 1,5 mm, dense setulosis et apice longe setosis alternantes; calycis lobi cum dentibus intersepalaribus et parte superiore tubi conjuncte caduci. *Petala* purpurea, obovata, 3 ⁄ 2,5 cm, margine ciliolata. *Stamina* 10 valde inaequalia; filamenta utrorumque verticillorum circ. 1,2 cm longa; antherae verticilli exterioris 10 mm longae, pedoconnectivo circ. 2,3 cm longo, basi biappendiculato, appendicibus circ. 1 mm longis; antherae verticilli interioris 11 mm longae, pedoconnectivo circ. 5 mm longo, basi biappendiculato, appendicibus circ. 0,75 mm longis sursum incurvis. *Stylus* elongatus circ. 3,2 cm longus. *Receptaculum fructiferum* immaturum urceolatum supra leviter constrictum.

Fl.: Oct.

Habitat in Rhodesia Australi, *Melsetter* dist., X-1950, *D. C. Plowes* 1216 (COI, typus; SRGH).

Affinis D. Trothae Gilg a qua caulibus foliisque brevius sparsiusque setosis, basi foliorum rotundata nec cordata, floribus in cymas paniculas laxas formantes nec ad apicem caulis ramorumque in dichasia capitata valde conferta dispositis, setis tubi calycis brevioribus, lobis calycis, petalis, staminibus et stylo majoribus, etc. differt.

Dissotis princeps (Bonpl.) Triana var. **Candolleana** (Cogn.) A. et R. Fernandes comb. nov. (Tab. IX et X)

Dissotis Candolleana Cogn. in A. et C. DC. Monogr. Phan. 7: 375 (1891). — Gilg in Engl. Monogr. Afr. Pfl.-Fam.-Gatt. 2, Melastom.: 19 (1898). — Hiern, Cat. Afr. Pl. Welw. **1** (2): 367 (1898). — Engl. in Engl. et Drude, Veg. Erde IX, Pflanzenw. Afr. 3 (2): 751 (1921). — Exell in Journ. of Bot. **67**, Suppl. Polypet.: 179 (1929). — Jac.-Fél. in Bull. Mus. Hist. Nat. sér. 2, **7**: 372 (1935). — Gossweiler et Mendonça, Cart. Fitogeogr. Angol.: 163 (1939). — Brenan et Greenway, Check-Lists For. Trees Shrubs Brit. Emp. N.° 5, Tangan. Terr. part II: 309 (1949). — Brenan in Mem. N. Y. Bot. Gard. 8: 440 (1954).

ANGOLA — CUANZA BOREALIS: *Pungo Andongo*, inter *Quitage* et *Condo*, *Welwitsch* 904 (BM; BR; COI; K; LISU); *Pungo Andongo*, *Funda Quilombo*, *Welwitsch* 904 b (BM; COI; K; LISU); *Pungo Andongo*, ad margines fluminis *Muxilo*, *Welwitsch* 904 c (BM; COI; K; LISU; P). QUANZA AUSTRALIS: *Novo Redondo*, *Amboim*, *Gossweiler* 4484 (BM; K); *Calulo*, *Libolo*, *Vumba*, *Gossweiler* 6386 (BM; COI; LISJC; LISU). MALANGE: *N'galo* pr. *Malange*, *Gossweiler* 1272 (BM; P); *Malange*, *N'Bango*, pr. *Muieba*, *Gossweiler* 1274 (BM; K; P). BENGUELLA: inter *Nova Lisboa* et *Teixeira da Silva*, alt. 1700 m, *Exell et Mendonça* 1829 (BM; COI; LISJC); *Nova Lisboa*, *Quipeio*, ad margines fluminis *Cuito*, alt. 1500 m, *Exell et Mendonça* 1910 (BM; COI; LISJC); *Nova Lisboa*, *Chicala*, *Exell et Mendonça* 3033 (BM; COI); *Nova Lisboa*, *Chianga*, flumen *Calupenda*, *Teixeira et Correia* 5 (COI; LUA). MOÇÂMEDES: s. l., *Berthelot* 75/95 (P). BIÉ: *Silva Porto*, alt. 1500 m, *Cardoso* s. n. (LISJC); pr. *Chinguar*, *Fenaroli* 1083 (HERB. FENAR.); *Sobado do Quimbundo*, *Jamaiambe*, ad margines fluminis *Cutato*, *Gossweiler*

2963 (BM; COI; K), 2963 a (BM; K). ?: *Lunti* (LUNDA?), *G. Boss* s. n. (numerus 36707 Herbarii Transvaalensis Musei) (PRE).

RHODESIA BOREALIS — *Mwinilunga* distr., pr. locum dictum *Kasingiko*, *Milne-Redhead* 833 (PRE); *Munshiwemba*, *Stohr* 65 (PRE).

NIASSALANDIA — *Kota-Kota* distr., *Nchisi Mt.*, alt. 1400 m, *Brass* 16902 (PRE); Niassa borealis distr., *Nyika Plateau*, *Nchena-chena Spur*, alt. 1400-1900 m, *Brass* 17353 (PRE); alt. 1340 m, *Brass* 17374 (PRE).

Dissotis denticulata sp. nov. (Tab. XI)

Frutex usque ad 1,60 m altus, satis ramosus. *Rami* ternati (semper?), obscure-hexagoni ad nodos incrassati et longe setosi, juniores setis subpatulis, primo stramineis deinde ferrugineis, pectinato-ramosis basi bulbosis dense obtecti, vetustiores scabri. *Folia* ternata vel opposita, petiolata, petiolis 2-12 mm longis, validis, setis eisdem caulium similibus obtectis; lamina ovato-lanceolata, 8×3,5 cm (vel ultra?), basi cordata, acutiuscula, ad margines manifeste denticulata, dentibus seta antrorsa munitis, 5-7-nervia, nervis supra impressis subtus prominentibus; pagina superior dense pilosa, pilis simplicibus, longiusculis, in papillas conicas insertis; pagina inferior molliter denseque villosa, pilis argenteis, longis, tenuibus, nervis setis (2-4 mm longis) validis basi bulbosa inaequaliter dentata dense obtectis; folia superiora (ramorum floriferorum) minora et proportionaliter latiora, basi profundius cordata, densius pilosa. *Cymae* 3-4-florae, confertae, in paniculas breves basi foliatas ad apicem ramorum collectae. *Flores* 5-meri, subsessiles. *Bracteae* caducae, usque 9×8 mm, ovato-orbiculares vel ovatae, obtusae. *Calycis tubus* cylindricus, 8-10×6-7 mm, appendicibus pediculato-capitatis (pediculo usque 2,5 mm longo, dense adpresseque setoso, apice capitato, capite dilatato longe stellato-setoso, setis albidis usque 2,5 mm longis) et pilis brevibus simplicibus vel plus minusve divisis basi bulbosa, densissime obtectus; dentes intersepalares appendicibus tubi calycis similes sed validiores (pediculo circ. 3 mm longo); lobi oblongi, in medio leviter constricti, 9×5 mm, margine ciliolati, dorso adpresse setulosi, apice oblique truncati et tuberculo stellato-setoso ornati. *Petala* pur-

purea circ. 2,8 × 2 cm. *Stamina* 10 valde inaequalia; antherae staminum majorum circ. 10 mm longae, pedoconnectivo circ. 1,5 cm longo, basi biappendiculato, appendicibus circ. 1 mm longis; filamentum 7 mm longum; antherae staminum minorum 8 mm longae, pedoconnectivo circ. 3 mm longo, basi biappendiculato, appendicibus circ. 0,5 mm longis; filamentum 10 mm longum. *Ovarium* ovoideum apice setosum, corona setarum validarum basim styli circumdanti. *Receptaculum fructiferum* cylindricum, 8-10 × 6-7 mm, capsulam includens.

Fl. e fr.: Jul.-Sept.

Habitat in Rhodesia Boreali, loco dicto *Shiwa Ngandu*, alt. 1600 m, 23-IX-1938, *Greenway* 5765 (EA; PRE, typus).

«A magenta flowered much branched shrub up to 5 ft. tall. A local dominant with *Syzygium cordatum*, *Dodonea viscosa*, *Lycopodium*, and very open *Phragmites communis* in a peat soil in areas that have been cleared of *Syzygium* sp. *Xylopia* swamp forest as a fringe to *Syzygium cordatum*, *Raphia*, *Uapaca*, *Gardenia imperialis* on stream banks».

Habitat etiam in Rhodesia Boreali inter *Serenje* et *M'Pika*, 16-VII-1930, *Pole Evans* 2909 (16) (PRE).

Affinis D. crenulatae Cogn. a qua foliis minoribus, profunde denticulatis neque crenulatis, densius et longius pilosis, pilis supra papillas insertis, petalis et staminibus minoribus, etc. differt.

Similis D. falcipilae Gilg margine foliorum et insertione pilorum in pagina superiore laminae, sed ab ea valde distincta foliis latioribus profunde cordatis, petiolo breviore, setis nervorum paginae inferioris albidis, plus minusve ramosis, basi bulbosa nec setis aureis squamiformibus, etc. differt.

Calvoa angolensis sp. nov. (Tab. XII)

Herba succulenta, annua vel perennis (ex collect.), partibus juvenilibus furfuraceo-puberulis, vetustioribus glabris. *Rami* crassi, acute tetragoni, manifeste 4-alati, primum virides, deinde cortice albido, nitido, longitudinaliter striato, lenticellis conspicuis munito, obtecti, ad nodos paulo incrassati. *Folia* siccitate tenuiter membranacea, late ovata, usque 9,5 × 6,2 cm, basi rotundata vel leviter cordata, apice breviter acuminata, supra

intense viridia subtus pallidiora, juniora sub lente manifeste, vetustiora obscure denticulato-setulosa, (3)-5-nervia sed jugo marginali tenuissimo usque ad mediam folii percurrenti; petiolus usque 4,5 cm longus. *Cymae* terminales, scorpioideae, multiflorae, simplices vel bifidae, 4-6,5 cm longe pedunculatae, floriferae 10 cm longae, fructiferae paulatim longiores usque 23 cm (vel ultra?). *Flores* aperti delapsi. *Alabastra* sessilia, basi bracteata, bracteis minutis sub cicatrice florum delapsorum persistentibus deinde caducis. *Calycis tubus* alabastri turbinatus, circ. 2×1,5 mm, furfuraceus; lobi triangulares, cuspidati. *Capsula* sessilis, albida, obpyramidata, 5-angularis, 10-costata, costis crassis, circ. 6×6 mm, basi truncata, squamis 5 cartilagineis, subquadratis, 3,5×3,5 mm, leviter emarginatis, reticulato-nervosis, ochraceis, coronata. *Semina* desunt.

Fl. et fr.: Jul.-Oct.

Habitat in Angola, regione Lunda, loco dicto *Dundo*, pr. flumen *Luachimo*, alt. 750 m, 28-X-1946, *Gossweiler* 13808 (BM); 8-VII-1949, *M. Fontinha* in *Gossweiler* 14261 (COI, typus; LUA).

« Succulent herb, annual or persistent, often exocormofita in humid situation ».

Affinis C. Sapinii De Wild. a qua foliis latioribus, ovatis nec ovato-oblongis, floribus sessilibus nec usque 10 mm longe pedicellatis, etc. differt.

A C. subquinquenervia De Wild. ramis acute tetragonis manifeste 4-alatis, vetustioribus albidis, nec obscure tetragonis et brunneo-purpureis, foliis majoribus, nervis transversis inconspicuis nec distinctis, inflorescentiis longioribus, capsulis basi truncatis nec breviter attenuatis, manifeste 5 angulatis, etc. differt.

Memecylon bipindense sp. nov. (Tab. XIII)

Memecylon bipindense Gilg in schede nom. nud.

Frutex? Arbor? Rami subtereti ad nodos valde incrassati, cortice griseo obtecti; ramuli novelli tetragoni, anguste 4-alati, siccitate brunnei. *Folia* oblongo-elliptica, 7-10,5 × 2,3-4,2 mm, opaca, coriacea, basi cuneata, apice abrupte longeque acuminata, acumine angusto, 1-1,5 cm longo, obtuso, siccitate supra

obscuro-viridia vel brunnea subtus ferruginea, 1-nervia, costa supra impressa subtus prominenti; petiolus brevis usque 2,5 mm longus. *Cymae* usque 1 cm longae, axillares, solitariae vel rarissime geminatae, pluriflorae, breviter pedunculatae, pedunculis compressis circ. 2 mm longis, ramulis usque 4 mm longis, pedicellis 2 mm; bracteae et bracteolae triangulares, carinatae, acutae, pedicelli breviores. *Flores* in alabastro subglobosi. *Receptaculum* cyathiforme, 3,5 × 3,4 mm, limbo leviter 4-sinuato, petala in alabastro non abscondenti. *Petala* rhomboidea, 2,5 × × 3,5 mm, obtusiuscula. *Staminum* filamenta circ. 2,3 mm longa; antherae circ. 1,25 mm longae, postice in rostrum breve productae. *Stylus* 4 mm longus; ovula 12. *Fructus* deest.

Fl.: ?

Habitat in *Kamerun* ad *Bipinde*, 1907, *Zenker* 3305 (COI, typus; PRE).

« Bipinde, Urwaldgebiet ».

Affinis M. Aylmerii Hutch. et Dalz. a quo foliis angustioribus, siccitate nigricantibus nec viridibus, petiolis brevioribus, inflorescentiis longioribus et laxioribus, pedicellis usque 2 mm nec 1 mm longis, bracteolis brevioribus, limbo calycis leviter 4-sinuato, petalis minoribus, antheris brevioribus rostro non longe producto, ovulis 12 nec 6, etc. differt.

Memecylon Exellii sp. nov. (Tab. XIV)

M. cinnamomoides sensu Exell in Journ. of Bot. **67**, Suppl. Polypet.: 183 (1929), non G. Don, Gen. Syst. **2**: 655 (1832) et Gilg in Engl. Mon. Afr. Pfl.-Fam.-Gatt. **2**, Melastom.: 39 (1898).

Frutex circ. 2 m altus. *Rami* juniores teretiusculi vel subtetragoni siccitate brunneo-purpurei, vetustiores nodosi, cortice griseo longitudinaliter fisso obtecti. *Folia* usque 3 mm longe petiolata, ovato-lanceolata, ovata vel late ovata, 5-8,5 × 2,2--5,6 cm, subcoriacea, basi rotundata rare leviter cuneata, apice in acumen acutissimum saepius falcatum abrupte contracta; lamina supra nitidula subtus opaca, 3-nervia, jugo laterali valido, paulo supra laminae basim abeunti et apicem fere attingenti,

inter nervos transversales non arcuato, reticulo venularum utrinque prominenti sed infra conspicuiore. *Cymae* axillares pauciflorae (1-3-florae, vel ultra?), laxae, umbelliformes; pedunculi tenues usque 8 mm longi; pedicelli graciles circ. 7 mm longi, basi bracteolati, bracteolis minutis, triangulari-lanceolatis, acutis. *Flores* apertos non vidimus. *Receptaculum* paulo post anthesin circ. 1 mm longum, limbo pateriformi circ. 3 mm diam. coronatum. *Fructus* niger (in sicco), oblique ellipsoideus, circ. 12×6 mm.

Fr.: Mart.

Habitat in Angola, regione Cabinda, loco dicto *Belize*, III-1917, *Gossweiler* 7053 (BM; LISJC; LISU, typus).

«Subarbusto de 2 m de altura com flores cor de violeta. Pluviisilva da área do Posto Militar de Belize, Alto Maiombe».

Affinis M. cinnamomoidi G. Don a quo petiolo breviore, foliis plerumque late ovatis nec ellipticis vel elliptico-oblongis, basi rotundatis nec angustatis, apice in acumen valde acutum, falcatum, abrupte contractis nec in acumen rotundatum vel obtusum terminatis, pedicellis longioribus (circ. 7 nec 3-4 mm longis), etc. differt.

Memecylon aggregatum sp. nov. (Tab. XV)

M. heterophyllum sensu Exell in Journ. of Bot. **67**, Suppl. Polypet.: 183 (1929), non Gilg in Engl. Monogr. Afr. Pfl.-Fam.-Gatt. **2**, Melastom.: 39 (1898).

Frutex 1,5 m altus. *Rami* juniores teretiusculi vel subangulati, cortice griseo mox obtecti. *Folia* 3-4 mm longe petiolata, petiolo supra canaliculato; lamina elliptica, 6,5-12 × 3,2-5,2 cm, basi cuneata, apice longe acuminata, acumine ipso rotundato, subcoriacea, supra nitentia subtus opaca, 3-nervia, nervis supra impressis subtus prominentibus, jugo laterali valido 3-4 mm supra basim laminae abeunti et fere usque ad apicem folii percurrenti, inter nervos transversales supra mediam saepe leviter incurvo; nervis transversalibus et reticulo venularum utrinque subaequaliter prominulis. *Cymae* pluriflorae in glomerulos axillares usque 1 cm longos aggregatae; pedunculi breves, 2,5-3 mm longi; pedicelli 1-2 mm longi, basi bibracteolati,

bracteolis minimis tarde deciduis. *Alabastra* parva non apiculata. *Receptaculum* campanulatum circ. 2×1,3 mm, in limbo profunde 4-lobato, circ. 2,5 mm diam. ampliatum, lobis rotundatis. *Petala* subrhomboidea, 2,3×3 mm. *Stamina* paulo exserta; filamenta circ. 2 mm longa; antherae circ. 1,5 mm longae.

Fl.: Jan.

Habitat in Angola, regione Cabinda, loco dicto *Buco Zau*, 23-I-1917, *Gossweiler* 6943 (BM; COI, typus; LISU).

« Arbusto de 1,5 m; corola cor de violeta, no estrato das microfanerófitas da floresta de Buco Zau, Maiombe ».

Affinis M. heterophyllo Gilg a quo (ex descriptione) ramis non acute tetragonis, foliis majoribus, brevius latiusque acuminatis, acumine in apice rotundato nec acuto vel acutiusculo, cymis plurifloris, brevioribus, in glomerulos axillares dispositis nec cymis 3-2-1-floris, etc. differt.

Memecylon melindense sp. nov. (Tab. XVI)

Arbor? Frutex? Rami vetustiores subteretes, nodosi, cortice siccitate cinerascenti obtecti, rami juniores purpurei, anguste 4-alati, fasciculis setarum caducarum in axillis foliorum dispositis; internodia 0,8-4 cm longa. *Folia* ovata vel elliptica, 1,4--3,7×1,2-2,3 cm, rigide coriacea, basi rotundata vel cuneata, apice breviter et obtuse acuminata, supra flavo-viridia, subtus brunneo-purpurea, margine leviter revoluta; 3-nervia, costa supra impressa subtus prominula, jugo laterali costae subaequivalido utrinque prominenti, ad laminae basim abeunti et fere usque folii apicem percurrenti, in parte circ. 1/3 superiore inter nervos transversales parce curvato; nervi transversales et venuli numerosi tenuissime et densissime reticulati, reticulo supra prominulo subtus colore plus minusve purpurascenti faciliter notato; petiolus 1-2 mm longus, supra sulcatus. *Inflorescentiae* cymulis subumbelliformibus paucifloris (usque ad 4-flores pro cymula), subsessilibus in foliorum axillis et in nodis foliorum delapsorum ramorum vetustiorum paucis aggregatis compositae; pedunculi usque 1 mm longi, apice bibracteati, bracteis triangularibus, apiculatis, coriaceis, circ. 1,5×0,75 mm; pedicelli graciles, 5-7 mm longi, basi bracteolati, bracteolis minimis, brunneo-pur-

pureis. *Alabastra* 3,75×3,25 mm, apice rotundata. *Receptaculum* depresso-turbinato-campanulatum, circ. 1,5×3 mm, limbo brevissimo, sinuato. *Petala* subquadrata vel obovata, bilobata, 2,5×2 mm, obscure unguiculata. *Staminum* filamenta 4,5-5 mm longa; antherae circ. 1,5 mm longae. *Stylus* 6-7 mm longus.

Fl.: Oct.

Habitat in Quenia, regione *Melinde* (*Malinde* Distr.), loco dicto *Arabuko*, X-1937, *J. R. Dale* 3835 (PRE, typus).

M. melindense inter species microphyllas 3-nervias collocandum est, sed distinctum:

A M. Schliebenii Markgr. foliis minoribus non auriculato-cordatis, floribus longius pedicellatis, stylo longiore, etc. differt.

A M. mouririifolio Brenan foliis brevius acuminatis vel fere non acuminatis, jugo laterali in tertio superiore inter nervos transversales tantum paulo arcuato, cymis aggregatis nec solitariis vel geminatis, breviter pedunculatis, floribus longe pedicellatis nec sessilibus vel subsessilibus, etc. differt.

A M. unifloro Exell etiam foliis brevius acuminatis, jugo laterali validiore a folii margine remotiore, in tertio superiore inter nervos transversales tantum paulo arcuato nec a basi inter nervos transversales arcuato, inflorescentiis pluri neque paucifloris, floribus minoribus, etc. differt.

A M. microphyllo Gilg foliis majoribus, basi non cordatis, floribus longe pedicellatis nec subsessilibus, limbo calycis sinuato nec profunde lobato, etc. differt.

Memecylon grandiflorum sp. nov. (Tab. XVII)

Frutex circ. 3,5 m altus. *Rami* juniores teretiusculi vel subangulati. *Folia* suborbicularia vel late ovata, subsessilia (vix 1 mm longe petiolata), basi rotundata vel truncata, apice obtuso vel latissime triangulari; vetustiora rigide coriacea, juniora submembranacea, opaca vel vix nitidula, luteo-viridia, margine incurva, 4,5-7,3×3,6-6,1 cm; 3-nervia (interdum 5-nervia sed jugo inferiore tenuissimo vix 1/3 folii percurrenti), jugo laterali inter nervos transversos a basi 3-5 arcuato, costa utrinque prominula, nervis transversalibus et venulis reticulatis, reticulo utrinque vix distincto sed in pagina superiore folio-

rum vetustiorum conspicuiore. *Inflorescentiae* cymulis 1-2, pedunculatis, axillaribus, paucifloribus, compositae; pedunculi usque 4 mm longi, compressi, apice dilatati, bibracteati; pedicelli 1,5 mm longi. *Flores* per gen. magni, circ. 10 mm, albi, ad basim 6 bracteolati, bracteolis coriaceis, opposito-decussatis, receptaculi basim plus minusve amplectentibus; bracteolae inferiores 2,5 × 2 mm, dorso carinatae, apice acuminatae; bracteolae medianae 4 × 4 mm, late cordiforme-ovatae, etiam dorso carinatae; bracteolae superiores concavae, 4 × 5,5 mm. *Receptaculum* 3,5 × 5,5 mm, parte inferiore subhemisphaerica, parte superiore campanulata. *Calycis lobi* latissime subsemiorbiculares, 3 × 5 mm, apice rotundati, coriacei. *Petala* coriacea, subrhomboidea, 6 × 6 mm, apice oblique rotundata. *Staminum* filamenta circ. 8 mm longa; antherae circ. 2,5 mm longae. *Stylus* 8,5 mm longus; ovula 12. *Fructus* deest.

Fl.: Feb.

Habitat in Africa Australi, regione *Lusikisiki*, loco dicto *Egoza*, 2-II-1929, *Galpin* 9568 (PRE, typus).

« Shrub 10 ft. high, flowers white, in deep shade in Egoza forest ».

M. grandiflorum speciebus floribus basi bracteolatis (M. Dinklagei Gilg ex Engl. et M. Barteri Hook. f.) probabiliter affinis est, sed forma foliorum, longitudine inflorescentiae et magnitudine florum valde distinctum.

Memecylon viridifolium Exell (Tab. XVIII et XIX)

Descriptio Cl. Exell in Journ. of Bot. **67**, Suppl. Polypet.: 185 (1929) sic amplificanda est:

Fructus ellipsoideus, circ. 11 mm longus et 7 mm latus, limbo calycis coronatus.

Fr.: Jan.

Habitat etiam in Congo Belgica, regione *Mayumbe*, loco dicto *Luki*, 10-I-1949, *C. Donis* 2295 (COI; YANG).

« Petit arbre de 7 m de haut ».

TABULAE

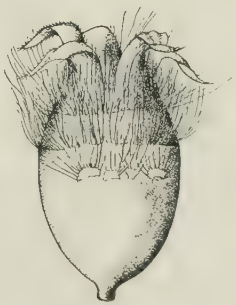
TABULA I

Tristemma rubens A. et R. Fernandes

a — Ramus fructifer. × 1/2.
b — Receptaculum fructiferum. × 2.

(*Gossweiler* 7866)

a



b

Rosette Fernandes
et Santos Figueira del.

Tristemma rubens A. et R. Fernandes

Melastomastrum Schlechteri A. et R. Fernandes

TABULA II

Melastomastrum Schlechteri A. et R. Fernandes

a — Fragmentum rami cum foliis, $\times$ 1.
b — Ramus florifer. $\times$ 1.
c — Receptaculum fructiferum. $\times$ 2.

(*Schlechter* 12782)

TABULA III

Dissotis debilis (Sond.) Triana var. **lanceolata**

(Cogn.) A. et R. Fernandes

Specimina *Welwitsch* 910 b, c, d. × circ. $^2/_5$.

Dissotis debilis (Sond.) Triana var. **lanceolata** (Cogn.) A. et R. Fernandes

Dissotis rupicola Gilg ex Engl.

TABULA IV

Dissotis rupicola Gilg ex Engl.

Specimen *Dinklage* 2139. × circ. 2/5.

TABULA V

Dissotis rupicola Gilg ex Engl.

a — Caulis cum ramis. × 1.
b — Fragmentum caulis. × 3.
c — Folii pagina inferior. × 3.
d — Flos inapertus. × 2.
e — Stamen verticilli exterioris. × 2.
f — Stamen verticilli interioris. × 2.
g — Semen. × 10.

(*Dinklage* 2139)

Ursula Beau
et Santos Figueira del.

Dissotis rupicola Gilg ex Engl.

Rosette Fernandes
et Santos Figueira del.

Dissotis arborescens A. et R. Fernandes

TABULA VI

Dissotis arborescens A. et R. Fernandes

a — Ramus cum foliis et gemmis floralibus. × 1.
b — Ramus florifer. × 1.
c — Ramus fructifer. × 1.
d — Calycis lobus superne visus. × 2.
e — Petalum. × 2.
f — Stamen verticilli exterioris. × 2.
g — Stamen verticilli interioris. × 2.
h — Receptaculum fructiferum. × 2.

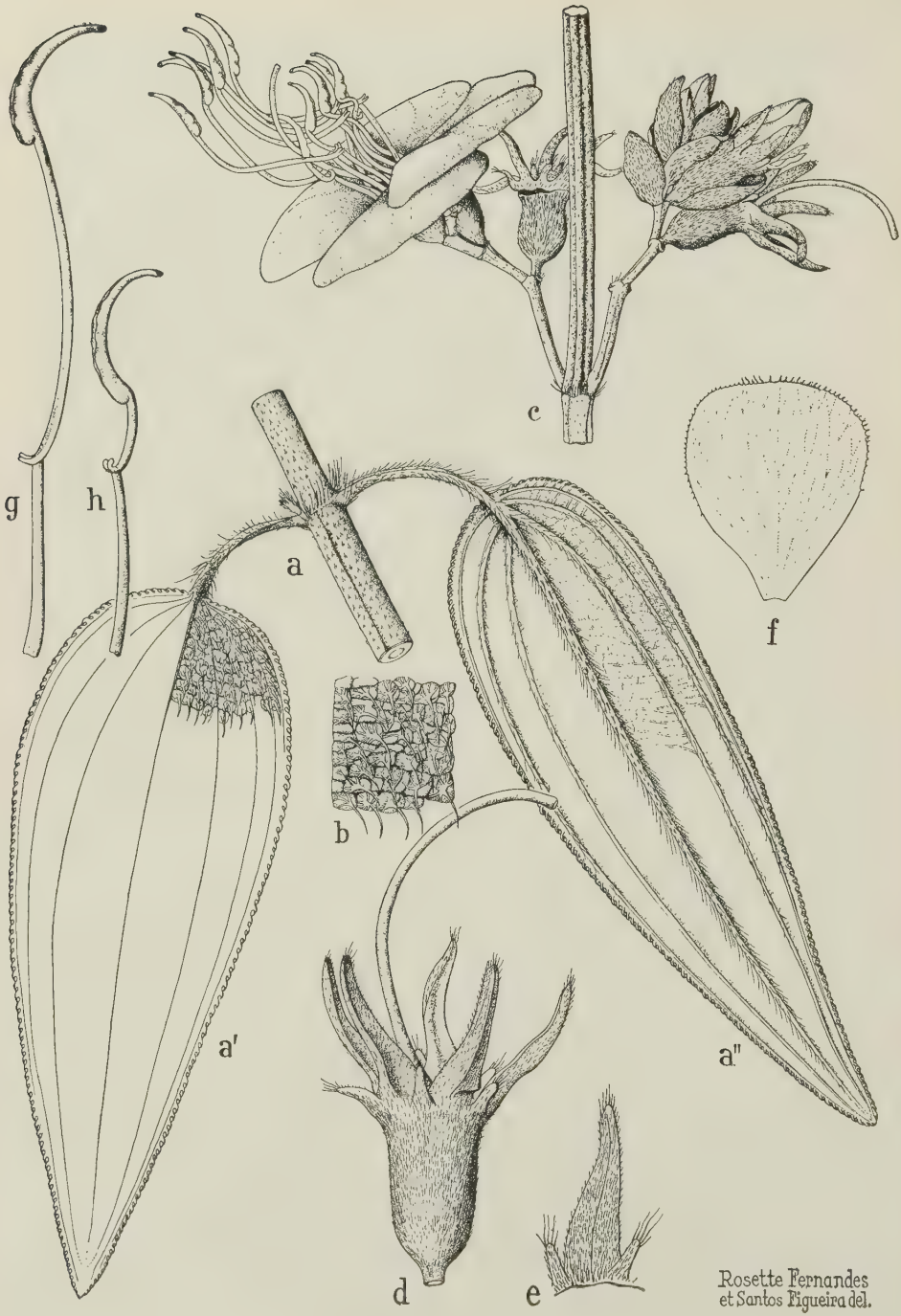
(*Greenway* 6176)

TABULA VII

Dissotis Bussei Gilg ex Engl.

Specimen *P. R. O. Bally* B 7899. × circ. $^2/_5$.

Dissotis Bussei Gilg ex Engl.



Dissotis pulchra A. et R. Fernandes

TABULA VIII

Dissotis pulchra A. et R. Fernandes

a — Fragmentum caulis cum foliis superne (a') et inferne (a") visis. × 1.
b — Segmentum paginae superioris folii cum setis super papillas conicas insertis. × 2,5.
c — Fragmentum paniculae cum flore aperto, flore inaperto et receptaculo fructifero immaturo. × 1.
d — Calyx post abscessionem petalorum. × 1.
e — Calycis lobus cum dentibus intersepalaribus. × 2.
f — Petalum. × 1.
g — Stamen verticilli exterioris. × 2.
h — Stamen verticilli interioris. × 2.

(*D. C. Plowes* 1216)

TABULA IX

Dissotis princeps (Bonpl.) Triana var.
Candolleana (Cogn.) A. et R. Fernandes

Specimen *Welwitsch* 904 b inflorescentiam confertam ostendens.
× circ. $^2/_5$.

Dissotis princeps (Bonpl.) Triana var.
Candolleana (Cogn.) A. et R. Fernandes

Dissotis princeps (Bonpl.) Triana var.
Candolleana (Cogn.) A. et R. Fernandes

TABULA X

Dissotis princeps (Bonpl.) Triana var.
Candolleana (Cogn.) A. et R. Fernandes

Specimen *Welwitsch* 904 c inflorescentiam laxam ostendens.
× circ. $^2/_3$.

TABULA XI

Dissotis denticutata A. et R. Fernandes

a — Ramus florifer. × 1.
b — Margo cum dentibus et pars paginae superioris folii cum setis super papillas conicas insertis. × 8.
c — Bracteae. × 2.
d — Flos inapertus. × 2.
e — Calycis lobus. × 2.
f — Dens intersepalaris. × 6.
g — Appendix calycis tubi. × 6.
h — Petalum. × 1.
i — Stamen verticilli exterioris. × 2.
j — Stamen verticilli interioris. × 2.
k — Receptaculum fructiferum cum capsula inclusa. × 2.

(*Greenway* 5765)

Dissotis denticutata A. et R. Fernandes

Calvoa angolensis A. et R. Fernandes

TABULA XII

Calvoa angolensis A. et R. Fernandes

a — Fragmentum caulis. × 1.
b — Apex rami cum foliis. × 1.
c — Margo folii. × 6.
d — Inflorescentia (flores evoluti delapsi). × 1.
e, f — Flores in alabastro. × 6.
g — Cyma fructifera. × 1.
h — Fructus × 2.

(a, b, c, g, h, specimen *Fontinha* in *Gossweiler* 14261; d, e, f, specimen *Gossweiler* 13808)

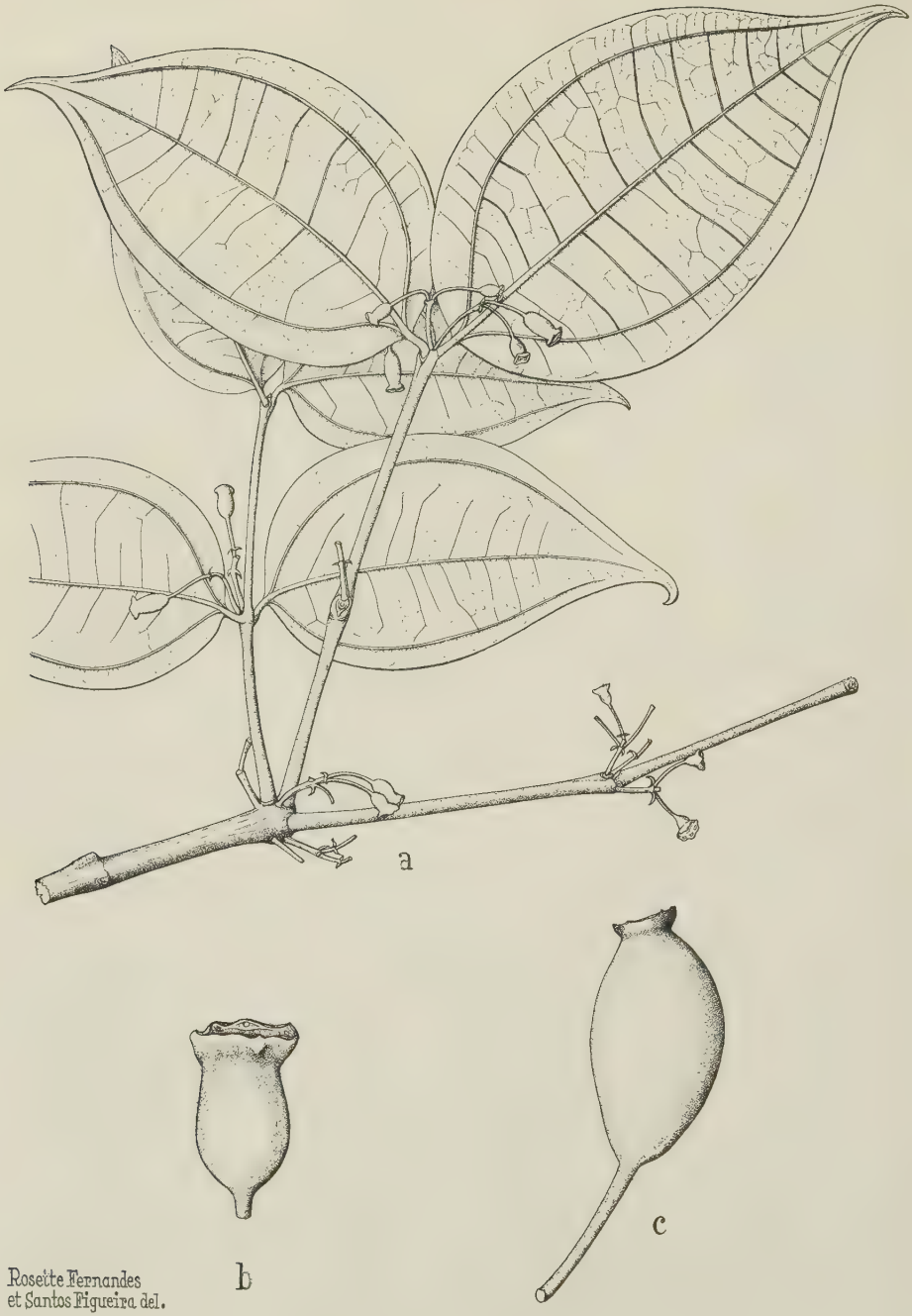
TABULA XIII

Memecylon bipindense Gilg ex A. et R. Fernandes

a — Ramus florifer. × 1.
b — Cyma. × 2.
c — Flos inapertus. × 4.
d — Petalum. × 4.
e — Stamen. × 4.
f — Receptaculum post abscessionem petalorum et staminum. × 4.

(*Zenker* 3305)

Memecylon bipindense Gilg ex A. et R. Fernandes



Rosette Fernandes
et Santos Figueira del.

Memecylon Exellii A. et R. Fernandes

TABULA XIV

Memecylon Exellii A. et R. Fernandes

a — Rami cum fructibus immaturis. × 1.
b — Fructus immaturus. × 4.
c — Fructus maturus. × 3.

(*Gossweiler* 7053)

TABULA XV

Memecylon aggregatum A. et R. Fernandes

a — Ramus florifer. × 1.
b — Folii pagina inferior. × 1.
c — Inflorescentia. × 1.
d — Cyma. × 4.
e — Alabastrum. × 4.
f — Alabastrum cum corolla aperienti. × 4.
g — Petalum. × 4.
h — Stamen. × 4.

(*Gossweiler* 6943)

Memecylon aggregatum A. et R. Fernandes

Memecylon melindense A. et R. Fernandes

TABULA XVI

Memecylon melindense A. et R. Fernandes

a — Rami floriferi. × 1.
b — Inflorescentia. × 2.
c — Flos in alabastro. × 4.
d — Petala. × 4.
e — Stamen. × 4.
f — Receptaculum cum stylo. × 4.

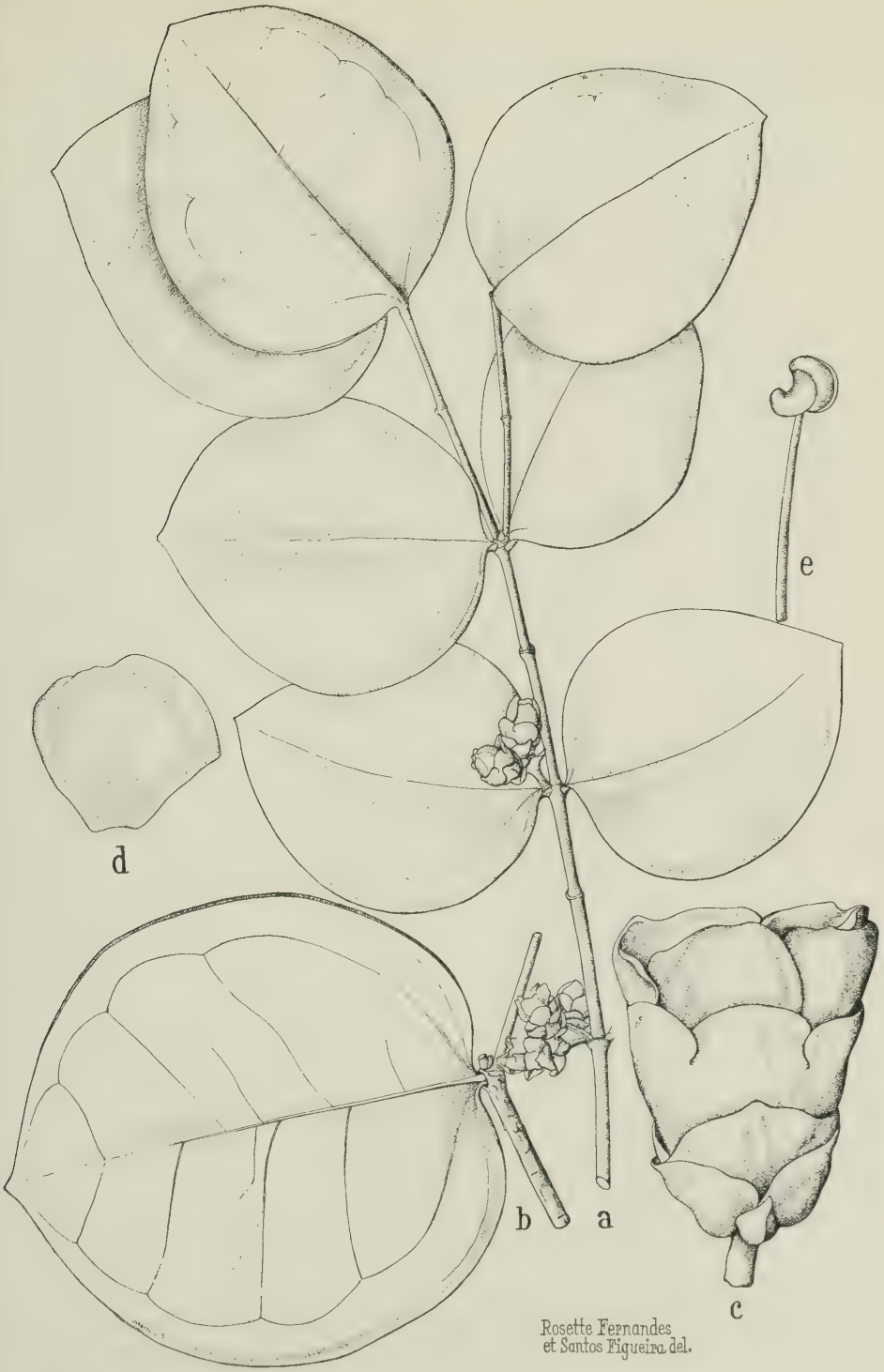
(*J. R. Dale* 3835)

TABULA XVII

Memecylon grandiflorum A. et R. Fernandes

a — Ramus juvenilis florifer. × 1.
b — Fragmentum rami paginam inferiorem folii adulti ostendens. × 1.
c — Flos basi bracteolatus. × 4.
d — Petalum. × 4.
e — Stamen. × 4.

(*Galpin* 9568)



Memecylon grandiflorum A. et R. Fernandes

Rosette Fernandes
et Santos Figueira del.

Memecylon viridifolium Exell

TABULA XVIII

Memecylon viridifolium Exell

a — Fragmentum rami cum foliis et inflorescentiis. × 1.
b — Cyma. × 2.
c — Petalum. × 5.
d — Stamen. × 5.
e — Receptaculum post abscessionem petalorum, staminum et styli, lateraliter visum. × 5.
f — Camara epigynica superne visa. × 5.

(*Gossweiler* 8039)

TABULA XIX

Memecylon viridifolium Exell

Specimen fructiferum, *C. Donis* 2295. × circ. $^{2}/_{5}$.

Memecylon viridifolium Exell

NOVIDADES DA FLORA DE ANGOLA

V

por

P. DUVIGNEAUD

Cryptosepalum elegans nov. sp.

Suffrutex caule elongato glabro, breviter desquamato, foliis 4-10 remotis, foliolis 14-18 jugatis, 15-28 mm longis et 6-10 mm latis, utrinque glabris, costa laterale, staminibus 3.

Malange: Malange, *Almeida* s. n. (Lis. JC); Ngolo, *Almeida* s. n. (Lis. JC); Malange, alt. 1040 m, *Antunes* 3094 (Lis. C; P, tipo); Mato de Catombe, *Gossweiler* 1381 (BM; K; P); Malange, *Gossweiler* 1389 (BM; K).

Cryptosepalum crassiusculum nov. sp.

Suffrutex caule breve glabro, persistenter squamoso, foliis 4-9 approximatis, foliolis 10-12 jugatis, 20-31 mm longis et 16--10 mm latis, utrinque glabris, costa submedia, staminibus generaliter 5-7.

Benguela: rio Cuvo, Bimbe, alt. 1800 m, *Gossweiler* 10658 (Coi); entre Nova Lisboa e Bimbe, alt. 1700 m, *Exell & Mendonça* 3055 (BM; Coi, tipo; Lis. JC), 3061 (BM; Coi; Lis. JC).

Cryptosepalum suffruticans nov. sp.

Suffrutex caule elongato piloso, breviter desquamato, foliis 6-8 sat remotis, foliolis 9-13 jugatis, 15-25 mm longis et 5-7 mm latis utrinque pilosis, costa submedia, staminibus 3-5.

Benguela: Cuandimba de Seca, prox. do Bissaya-Cacondo, *Gossweiler* 1764 (BM, tipo; Coi; Lis. JC).

Obs. Não é senão provàvelmente uma variedade reduzida ao estado de sufrutice de *C. arboreum*.

Cryptosepalum subelegans nov. sp.

Suffrutex caule breve, glabro basi rufo-pilosa excepta, persistenter squamoso, foliis 3-5 approximatis, foliolis 9-14 jugatis, 10-12 mm longis et 3-6 mm latis utrinque glabris, costa submedia, staminibus 3.

Lunda: Entre Dala e Vila Henrique de Carvalho, *Young* 367 (BM, tipo).

LYTHRACEAE AFRICANAE NOVAE

AUCTORIBUS

A. FERNANDES et M. A. DINIZ

Instituti Botanici Universitatis Conimbrigensis

Rotala longicaulis sp. nov. (Tab. I)

Herba aquatica. *Caules* 60 cm longi vel ultra, inferne longe defoliati et ad nodos radicantes, superne foliosi et saepe sub apice ramosi, ramis plus minusve elongatis; internodia 8-16 mm longa, sub apice multo breviora. *Folia* 4^na^, sed in primo nodio ramorum opposita, homoeomorpha, oblongo-lanceolata, usque 10 × 3 mm, basi in petiolum brevissimum abrupte contracta, apice obtusa, obscure penninervia, plerumque internodiis longiora, ad apicem ramorum conferta. *Flores* (3-) 4 (-5)-meri, homoeomorphi (?), axillares, sub anthesi circ. 1 mm longe pedicellati; bracteolae 2, minutae, membranaceae, lineares, pedicellum paulo superantes. *Calyx* campanulatus, circ. 2,5 mm longus, exappendiculatus; lobi late triangulares circ. 0,5 mm longi. *Petala* rubra, anguste oblongo-lanceolata, circ. 2 × × 0,75 mm, obtusa, ad basim sensim attenuata. *Stamina* tot quot sepala, paulo infra medium tubum inserta, apicem loborum vix aequantia. *Ovarium* ellipsoideum, conspicue stipitatum, circ. 1 × 0,75 mm, 2-3-loculare; stylus 3,5 mm longus, longe exsertus. *Capsula* 2-3-valvis, circ. 1,5 × 1 mm. *Semina* circ. 0,5 mm longa.

Fl. et fr.: Maj.

Habitat in *Moçambique*, regione Niassa, loco dicto *Metonia* pr. *Vila Cabral*, in paludosis, 23-V-1934, *Torre* 96 (COI, typus; LISC).

« Erva dos lugares pantanosos, flores carmim ».

Affinis R. myriophylloidi Hiern (sect. Hippuridium Koehne, subsect. Eurotala Koehne) a qua caulibus longioribus et

robustioribus, foliis homoeomorphis eisdem R. myriophylloidis emersis similibus sed longioribus et latioribus, floribus (3-) 4 (-5)-meris nec omnibus 4-meris, petalis anguste oblongo-lanceolatis nec rhomboideo- vel cordato-orbicularibus, etc. differt.

Rotala tetragonocalyx sp. nov. (Tab. II)

Herba amphibia. *Caules* prostrati, foliosi vel defoliati, ad nodos radicantes, 40 cm longi vel ultra, ramos emersos, ascendentes, leviter 4-alatos, usque ad 12 cm altos emittentes. *Folia* decussata ; caulina sessilia, tenuissime membranacea, late elliptica, basi cordata, usque 18 × 11 mm, nervo mediano paulo conspicuo ; ramea etiam sessilia, late elliptica vel fere orbicularia, basi cordata, apice rotundata, circ. 2,5-6 × 1,5-5,5 mm, obscure penninervia, sub apice ramorum minora et confertiora. *Flores* 4-meri, subsessiles in axillis foliorum superiorum ; bracteolae 2, minutae, subulatae, circ. 1 mm longae. *Calyx* tubulosus, semper manifeste 4-gonus, ore leviter constrictus, sub anthesi 2,5 mm, fructifer usque ad 3,5 mm longus ; lobi 4, brevissimi, fere truncati, vix apiculati ; appendices circ. 1 mm longae, subulatae, erectae, plerumque sursum incurvae. *Petala* 1 × 0,75 mm, subrotundata, apice leviter emarginata, os calycis tubi circ. 0,5 mm superantia. *Stamina* 4, paulo infra medium tubum inserta, circ. 4/5 tubi attingentia ; antherae minutae, circ. 0,25 mm. *Ovarium* ellipsoideum, circ. 1,5 mm longum ; stylus stigmate late capitato paulo longior, antheras fere aequans. *Capsula* 4-valvis, 3,5 mm longa, ellipsoidea, tubum calycis aequans. *Semina* numerosa, concavo-convexa, circ. 0,5 mm longa.

Fl. et fr. : Jun.-Aug.

Habitat Angola, regione Huilla, loco dicto *Humbe*, in coeno sicco fluminis *Cunene*, 11-VI-1937, *Exell et Mendonça* 2834 (BM ; COI, typus ; LISJC).

Habitat etiam in eadem regione Huilla, loco dicto *Calueque*, in coeno fluminis *Cunene*, 29-VIII-1954, *Pritchard* 383a (BM ; COI ; LISC) et in Congo Belgica, in paludosis fluminis *Mangoa*, 23-VII-1932, *Young* 243 (BM ; COI).

Affinis R. Ritchiei (Clarke) Koehne (sect. Enantiorotala Koehne subsect. Sellowia Koehne, series 2) a qua (ex des-

criptione) foliis rameis brevioribus et latioribus, late elipticis vel suborbicularibus basi cordatis, nec oblongis basi obtusissimis, calycibus circ. 2,5 mm nec 2 mm longis, semper 4-gonis nec demum anguste cyathiformibus ac teretibus, petalis subrotundatis apice leviter emarginatis nec obovatis, etc. differt.

Rotala congolensis sp. nov. (Tab. III)

Herba palustris. *Caules* 15 cm longi vel ultra (prostrati et inferne radicantes?), superne foliosi et ramosi, ramis brevibus, ascendentibus, plus minusve 12 mm longis; internodia circ. 10 mm longa, sub apice breviora. *Folia* caulina decussata, sessilia, late cordato-ovata, apice obtusa, tenuiter membranacea, penninervia, 7-9 × 5-7 mm; ramea ovata, basi cordata, 3-3,5 × 1,5 mm. *Flores* 4-meri, solitarii, subsessiles in axillis foliorum ramorum; bracteolae 2, tenuiter membranaceae, subulatae, circ. 1/2 calycis tubi aequantes. *Calyx* sub anthesi 1,5 mm longus, campanulatus, exappendiculatus, lobis deltoideis, acuminatis, circ. 1/2 tubi aequantibus. *Petala* saepe omnia nulla, raro 3, quorum 2 lanceolata, lobis breviora, et 1 subulata (alios typos non vidimus). *Stamina* 2, paulo infra ad 1/2 tubi inserta, loborum partem medianam attingentia. *Ovarium* 2-loculare, globosum, sessile, 0,5 mm longum; stylus circ. 1/3 ovarii aequans. *Capsula* ellipsoidea, 2-valvis, lobos subaequans. *Semina* ellipsoidea, pallida.

Fl. et fr.: Maj.

Habitat in Congo Belgica, loco dicto *Keyberg* pr. *Elisabethville*, V-1948, *A. Schmitz* 1684 (COI, typus; YANG).

Affinis R. heteropetalae Koehne (sect. Enantiorotala, subsect. Suffreniopsis, series 1) a qua (ex descriptione) foliis longioribus et latioribus, apice obtusis, lobis calycis longius acuminatis, petalis saepe nullis, evolutis lanceolatis, stylo breviore, etc. differt.

Rotala urundiensis sp. nov. (Tab. IV)

Herba palustris, caespitosa (?). *Caules* erecti, 10-15 cm longi, simplices vel plus minusve ramosi, anguste 4-alati, inferne

defoliati et radicantes; internodia usque ad 10 mm longa, sub apice multo breviora. *Folia* decussata, subsessilia, ovato-orbicularia, basi cordata, apice obtusissima, penninervia, inferiora usque ad 5,5 × 5,5 mm, internodia breviora, ramea 3,5 × 3,5 mm, internodia longiora. *Flores* 4-meri, subsessiles, solitarii in axillis foliorum ramorum et caulinarum superiorum; bracteolae lineares, breves, scariosae. *Calyx* campanulatus, 1,5 mm longus; tubus circ. 0,8 mm longus; lobus anterior late deltoideus, 0,75 × 1,25 mm; lobus posterior anguste triangularis, 0,75 × × 0,8 mm; lobi laterales etiam anguste triangulares, 0,75 × × 0,75 mm; appendices subnullae vel 0. *Petala* 0. *Stamina* 2, paulo supra basim tubi inserta, filamentis partem medianam loborum attingentibus. *Stylus* 0,5 mm longus. *Capsula* subglobosa, 3-valvis, lobos calycis subaequans. *Semina* plano-convexa, rubescentia, 0,35 mm longa.

Fl. et fr.: Sept.

Habitat in Congo Belgica, regione *Urundi*, loco dicto *Mosso de Rujigi*, IX-1951, *Michel et Reed* 228 (COI, typus; YANG).

Affinis R. Gossweileri Koehne (sect. Enantiorotala, subsect. Suffreniopsis, series 1) a qua habito robustiore, caulibus ramosioribus, foliis fere orbicularibus, basi distincte cordatis, 3,5-5,5 × 3,5-5,5 mm, nec foliis late ovatis, basi subcordatis, 2-3 × 1,5-2,2 mm, calycis lobis brevioribus et latioribus, seminibus rubescentibus nec pallidis, etc. differt.

Rotala thymoides Exell var. **angustifolia** nov. var. (Tab. V)

A typo foliis oblongo-linearibus usque 7 × 1,5 mm, calycis tubo longiore circ. 2 nec 1,75 mm, lobis longioribus circ. 1 nec 0,75 mm et petalis majoribus differt.

Fl.: ?

Habitat in Angola, regione Huilla, s. l., s. d., *Antunes et Dekindt* 615 (LISC, typus).

Hionanthera gen. nov.

Flores typice 4-meri, interdum 3- vel 5-meri. *Calyx* campanulatus, scarioso-corollinus, inferne usque ad staminum inser-

tionem 8- supra manifeste 4-nervatus, appendicibus brevibus, fundo annulo nectarifero munitus. *Petala* persistentia, corrugata. *Stamina* 4 (interdum 3 vel 5) episepala; antherae dorso affixae; pollen intense violaceum consequenter etiam antherae. *Ovarium* sessile vel breviter stipitatum, dissepimentis supra columnam placentarem interruptis (placenta igitur cum stylo haud continua), incomplete 2-loculare, 2-5-ovulatum; stylus manifestus. *Capsula* tenuissime membranacea, irregulariter rumpens. *Semina* tot quot ovula, vel minus, per fam. magna. — *Herbae* annuae vel perennes, aquaticae vel palustres, graciles, glaberrimae. *Caulis* ramique plus minusve 4-goni. *Folia* decussata, sessilia, linearia, basi tantulum dilatata, conduplicata vel supra canaliculata, nervo medio subtus carinato-incrassato. *Flores* in dichasiis axillaribus, glomerulos pluri- vel multifloros dense confertos, a basi foliorum amplexos, formantibus; bracteolae primi ordinis 2, oppositae, glomerulos plus minusve aequantes, lineares, foliaceae vel membranaceae, caeterae numerosae, parvae, subulatae, membranaceae, albidae.

Genus inter Rotalam et Ammanniam collocandum est.

Typus Hionanthera mossambicensis nob.

Hionanthera mossambicensis sp. nov. (Tab. VI)

Herba aquatica, caespitosa (ex collect.). *Caules* simplices vel parce ramosi, usque ad 45 cm longi (probabiliter ultra), 4-goni, 4 mm diam., inferne defoliati et radicantes, superne foliosi, partibus mediis plerumque minute nigro-punctatis; internodia usque 4,5 cm longa, sub apice multo breviora. *Folia* ascendentia vel erecta, usque 6 cm longa, basi tantulum dilatata (circ. 3 mm lata), apice sensim attenuata, apice ipso acuto, uninervia, nervo conspicuo. *Flores* (3-) 4 (-5)-meri; glomeruli multiflori densissime conferti; pedicelli florium evolutorum usque 1 mm longi; bracteolae primi ordinis foliaceae, lineares, usque ad 3,5 × 0,75 mm, caeterae lineares, minutae (circ. 1 mm), tenuissime membranaceae, albidae. *Calyx* campanulatus 1,5 × × 1 mm; lobi breves vel brevissimi, leviter apiculati, circ. 1 mm lati; appendices breves, lobos paulo superantes. *Petala* violacea (ex collect.), corrugata, oblonga, 1 mm longa, apice interdum leviter emarginata. *Stamina* 4, paulo infra medium tubi inserta,

2-2,25 mm longa, circ. 1,5 mm exserta. *Ovarium* obovatum, circ. 0,5 mm longum, 2-4-ovulatum; stylus 2 mm longus, ovario multo longior et stamina subaequans. *Capsula* ellipsoidea, circ. 2 mm longa, paulo exserta, parietibus nigro-violaceis. *Semina* plerumque 2, nigro-violacea, circ. 1,75 × 1 mm.

Fl. et fr.: Febr.

Habitat in *Moçambique*, *Moçambique* distr., loco dicto *Nampula*, in paludosis, 7-II-1936, *Torre* 719 (COI, typus; LISC).

« Erva rizomatosa, cespitosa, frequente na água corrente dos charcos, flores violáceas ».

Hionanthera graminea sp. nov. (Tab. VII)

Herba palustris, caespitosa (ex collect.). *Caules* straminei, graciles, flexuosi, simplices, usque ad 40 cm longi, inferne radicantes et longe defoliati, superne foliati; internodia usque ad 6 cm longa sub apice breviora. *Folia* usque 2,5 cm longa, basi rubescentia et dilatata, apice acuminata, conduplicata vel canaliculata, subtus carinata. *Flores* 4-meri, usque ad 1 mm longe pedicellati, glomerulis pluriflоris dispositi; bracteolae infimae lineariae, membranaceae, usque 3 × 1 mm, apice acutae, supra canaliculatae infra carinatae, plerumque violaceae; bracteolae caeterae subulatae, albidae vel roseae. *Calyx* campanulatus, lilacineus vel roseus, usque ad 1,5 mm longus; lobi breves, late deltoidei, apiculati; appendices etiam breves, apicula loborum aequantes. *Petala* oblonga, pallide lilacina (ex collect.), corrugata, circ. 1 mm longa. *Stamina* 4, circ. 1,5 mm longe exserta. *Ovarium* obovoideum, 0,5 mm longum, 2-ovulatum; stylus plus minusve 1,5 mm longus. *Capsula* nigro-violacea, circ. 0,5 mm exserta. *Semina* 2, castanea, concavo-convexa, circ. 1,5 × × 0,75 mm.

Fl. et fr.: Mart.

Habitat in *Moçambique*, *Moçambique* distr., loco dicto *Nampula*, in paludosis, 1-III-1936, *Torre* 715 (COI, typus; LISC).

« Erva aquática, cespitosa, dos lugares pantanosos, corola pálido-lilacínea ».

Affinis H. mossambicensi nob. a qua caulibus gracilibus longe defoliatis, foliis patulis brevioribus et angustioribus, bracteolis infimis membranaceis, bracteolis caeteris longioribus, ovario 2-ovulato nec 2-4-ovulato, etc. differt.

Hionanthera Torrei sp. nov. (Tab. VIII)

Herba annua (ex collect.), procumbens. *Rami* ascendentes, inferne radicantes, 25 cm longi (probabiliter ultra), 2,5 mm diam.; internodia usque ad 4 cm longa, sub apice multo breviora. *Folia* patula vel sub apice ramorum ascendentia vel erecta, usque 4,5 cm longa, basi dilatata usque 3 mm lata, apice acuta, uninervia, nervo conspicuo. *Flores* 4-meri, usque 1 mm longe pedicellati, in glomerulis multifloris densissime confertis dispositi; bracteolae infimae tenuiter membranaceae, plerumque roseae, lanceolatae, usque $3 \times 1{,}5$ mm, acutae; bracteolae caeterae albidae, bracteolis infimis similes, sed paulatim minores et tenuiores. *Calyx* campanulatus, fere truncatus, 1,5 mm longus; lobi subnulli, breviter apiculati; appendices breves, triangulares. *Petala* 4, alba (ex collect.), corrugata, oblonga, 1,25 mm longa. *Stamina* 4, calycis lobos circ. 1 mm superantia. *Ovarium* obovatum, circ. 0,5 mm longum, 2-ovulatum; stylus 2 mm longus, stamina aequans vel paulo superans. *Capsula* ellipsoidea, lobos paulo superans. *Semina* 2, concavo-convexa, circ. $1 \times 0{,}5$ mm, nigro-violacea.

Fl. et fr.: Febr.

Habitat in *Moçambique*, *Moçambique* distr., loco dicto *Nampula*, 21-II-1937, *Torre* 1212 (COI, typus; LISC).

«Erva anual, radicante, flores brancas, abundante na camada terrosa sobre as rochas, mato xerófilo».

Affinis H. mossambicensi nob. a qua caulibus minus robustis, ramosioribus, foliis inferioribus et medianis patulis nec omnibus ascendentibus vel erectis, brevioribus, basi abruptius dilatata, bracteolis infimis membranaceis nec foliaceis, bracteolis caeteris majoribus, petalis albis nec violaceis, ovario 2-ovulato, seminibus 2 nec 2-4, etc. differt.

Hionanthera Garciae sp. nov. (Tab. IX)

Herba annua vel perennis, erecta, usque ad 15 cm alta. *Caulis* inferne crassiusculus, probabiliter coeno submersus, ad nodos et internodia dense radicans, superne ramosus, ramis ascendentibus vel erectis, oppositis; internodium infimum plus minusve submersum usque ad 4 cm longum; internodia superiora caulium ramorumque usque ad 3,5 cm, sub apice multo breviora. *Folia* basalia (2 in speciminibus visis) opposita, ad nodum infimum inter radices disposita, oblonga, apice rotundata, uninervia, tenuiter membranacea, circ. 17 × × 4 mm; folia secundi nodi linearia, circ. 6 × 1,5 mm, tenuiter membranacea; folia superiora subpatula vel fere erecta, usque ad 4 cm longa et 2 mm lata (plerumque breviora et angustiora), basi tantulum dilatata, apice acuta vel acutiuscula. *Flores* 4-meri, interdum 5-meri, in glomerulis plurifloris dispositi; bracteolae infimae lineariae, apice acutae, tenuissime membranaceae, albidae vel pallide roseae, circ. 2 × 0,5 mm; bracteolae caeterae infimis similes sed paulatim minores et tenuiores. *Calyx* late campanulatus, 1,25 mm longus; lobi deltoidei circ. 1/4 tubi aequantes; appendices brevissimae, plica marginis calycis constitutae. *Petala* lilacina, corrugata, 0,75 mm longa. *Stamina* 4, exserta, circ. 0,75 mm longa, lobos superantia; antherae 0,25 mm longae. *Ovarium* obovoideum, (4-) 5-ovulatum; stylus circ. 1 mm longus antheras aequans. *Capsulam* et *semina* non vidimus.

Fl. et fr.: Mart.

Habitat in *Moçambique, Manica e Sofala* distr., loco dicto *Serra de Bandula* pr. *Chimoio*, 28-III-1948, *Garcia* 790 (LISC, typus).

«Erva anual ou vivaz do mato humoso sobre rocha húmida».

Affinis H. Torrei nob. a qua habito humiliore, erecto a basi ramoso, foliis infimis oblongis, foliis superioribus minoribus et tenuioribus, inflorescentiis paucifloris, calycis lobis manifeste deltoideis nec subnullis, ovulis (4-) 5 nec 2, etc. differt.

Nesaea angolensis sp. nov. (Tab. X)

Herba annua, gracilis, 2-6 cm alta. *Caulis* erectus, simplex, conspicue 4-alatus, radicibus tenuibus basi munitus. *Folia* decussata, saepe internodiis longiora, oblongo-elliptica, obscure penninervia, supra intense viridia, subtus pallidiora, margine angustissime albido minutim serrulata; inferiora 8 × 2 mm in petiolum brevissimum sensim attenuata, apice obtusiuscula; superiora usque 12 × 4 mm, basi obtusa vel subcordata, in petiolum brevissimum abrupte contracta, apice etiam obtusiuscula. *Dichasia* subsessilia, plerumque 3-flora; pedicelli usque 1,5 mm longi; bracteolae infimae circ. 1,75 mm longae, lineares, acutae, carinatae, caeterae subulatae. *Flores* 4-meri. *Calyx* campanulatus circ. 2 mm longus; tubus 1,5 mm longus; lobi circ. 1/4 tubi aequantes; appendices sursum incurvae, lobis longiores, apice ciliolatae. *Petala* 0. *Stamina* 4, episepala, circ. ad 1/3 tubi inserta, antheris os tubi attingentibus. *Ovarium* globosum, circ. 0,75 mm longum; stylus 0,3 mm longus stigmate longior. *Capsula* globosa, lobis calycis introflexis abscondita. *Semina* numerosa, flavescentia.

Fl. et fr.: Jun.

Habitat in Angola, regione Huilla, loco dicto *Ruàcaná*, alt. 1000 m, 9-VI-1937, *Exell et Mendonça* 2748 (BM; COI, typus).

«Erva anual dos lugares húmidos entre as rochas».

Habitat etiam ad stagnum artifactum pr. locum dictum *Musseque de Luiz Gomes*, non procul a Luanda, II-1858, *Welwitsch* 2370 (LISU).

Affinis N. loandensi (Hiern) Koehne (sect. Ammanniastrum Koehne, series 1) a qua habito erecto nec prostrato, caule gracili, simplici usque ad 6 cm longo, nec caule e basi ramoso 7-15 cm longo, foliis oblongo-ellipticis apice obtusiusculo nec foliis ovato-oblongis vel lanceolatis apice acuto, brevioribus (8-12 nec 9-17 mm) et angustioribus (2-4 nec 4-9 mm), dichasiis 3-floris nec multifloris, appendicibus lobis longioribus nec lobis aequilongis vel vix longioribus, etc. differt.

Nesaea Pedroi sp. nov. (Tab. XI)

Herba annua usque ad 16 cm alta. *Radix* fibrillis tenuibus constituta. *Caulis* erectus, simplex vel parce ramosus, 4-angulatus vel angustissime 4-alatus. *Folia* decussata, sessilia, plus minusve patula vel ascendentia, linearia, 8-25 × 1,5-2 mm, basi attenuata, apice acuta, uninervia, rigidula, glabra, margine minutissime serrulata. *Flores* 4-5-meri, trimorphi, in capitulis involucratis paucifloris aggregati; capitula usque 3 mm longe pedunculata; bracteolae involucrantes 2, amplae, foliaceae, venulosae, 4 × 5 mm, superne dilatatae, truncatae, in acumen breve ciliolatum contractae; bracteolae interiores tenuiter membranaceae, plus minusve anguste-lanceolatae, calycem aequantes, margine superne ciliata, nervo mediano conspicuo. *Calyx* turbinato-campanulatus, circ. 3,5 mm longus, 8- vel 10-nervatus; lobi introflexi, late deltoidei, apiculati, circ. 1/4 tubi aequantes vel multo breviores; appendices arcuato-inflexae, circ. 0,75 mm longae, pilis brevibus, crassis, albis ornatae. *Petala* purpurascentia (ex collect.), caduca, obovata, unguiculata, circ. 3,5 × × 2,5 mm. *Stamina* 8 vel 10, paulo supra basim tubi inserta, sed episepala paulo infra epipetala; flores dolichostyli: stamina episepala longe exserta, epipetala longitudinem appendicum circ. duplum superantia, stylus 6,8 mm longus, partem exsertam staminum episepalorum circ. 1/4 superans; flores mesostyli: stamina episepala longe exserta, epipetala longitudinem appendicum circ. duplum superantia, stigma circ. 1 mm infra antheras staminum episepalorum; flores brachystyli: stamina episepala longe exserta, epipetala circ. 1,5 mm appendices superantia, stigma paulo infra antheras staminum epipetalorum. *Ovarium* elliptico-ovoideum, 2-loculare. *Capsulam* maturam non vidimus.

Fl.: Jul.

Habitat in *Moçambique, Moçambique* distr., loco dicto *Môma*, in paludosis, 15-VII-1948, *Pedro et Pedrógão* 4523 (COI, typus; LMJ).

« Planta herbácea, anual, flores purpurascentes, local pantanoso junto a mangal ».

Affinis N. erectae Guill. et Perr. [sect. Typonesaea Koehne, subsect. Tolypeuma (E. Mey.) Koehne] a qua foliis linearibus

angustioribus, 1,5-2 nec 2-5 mm latis, capitulis subsessilibus vel breviter pedunculatis, pedunculis usque 3 nec 3-15 mm longis, capitulis minoribus, paucifloris (plerumque 3 nec 6-floris evolutis), bracteolis involucrantibus minoribus (circ. 1/2), non viridiscentibus, etc. differt.

Nesaea pygmaea sp. nov. (Tab. XII)

Herba annua, filiformis, glabra, usque ad 6 cm alta. *Radix* fibrillis tenuibus constituta. *Caulis* erectus, simplex vel parce ramosus, 4-gonus vel anguste 4-alatus; internodia inferiora usque 12 mm, superiora breviora, plerumque 3-4 mm longa. *Folia* decussata, ovato-lanceolata, usque 6 × 3 mm, basi rotundata, truncata vel leviter cordata, apice acutiuscula, uninervia, inferiora et mediana internodiis breviora, superiora internodia aequantia vel superantia. *Flores* 4-meri in dichasia pedunculata, capituliformia, involucrata, 1-3-flora, in axillis foliorum superiorum caulium romorumque; pedunculi 1,5-4 mm longi; bracteolae involucrantes 2, ovatae-lanceolatae, circ. 2,5 × 1,25 mm, viridiscentes, venosae, apice recurvatae, caeterae lineares, tenuiter membranaceae, 1/2 calycis superantes. *Calyx* turbinato-campanulatus, 1,5 mm longus, 8-nervius; lobi deltoidei, introflexi, tubi circ. 1/4 aequantes; appendices erectae, lobis multo longiores, circ. 0,75 mm longae, non ciliolatae. *Petala* vinosa, 1 × 0,75 mm, obovata, unguiculata, apice leviter emarginata. *Stamina* 4, episepala, paulo infra medium tubi inserta, appendices breviter superantia. *Ovarium* subglobosum, 2-loculare; stylus circ. duplo ovario longior, stamina paulo superans. *Capsula* lobos calycis vix superans.

Fl. et fr.: Apr.

Habitat in *Moçambique*, *Moçambique* distr., inter *Nampula* et *Corrane*, locis siccis, super saxa frequens, 11-IV-1937, *Torre* 1365 (COI, typus; LISC).

« Erva anual com flores vinosas. Abundante no cimo das rochas, lugares secos. »

Affinis N. Pedroi nob. [sect. Typonesaea Koehne, subsect. Tolypeuma (E. Mey.) Koehne] a qua habito humiliore, caulibus filiformibus, foliis ovato-lanceolatis nec linearibus, pedunculis

plerumque longioribus, capitulis minoribus paucifloris (plerumque 1- nec 3-floris), bracteolis involucrantibus minoribus et ovato-lanceolatis nec superne dilatatis, appendicibus non ciliolatis, staminibus 4 nec 8 vel 10, etc. differt.

Nesaea ramosissima sp. nov. (Tab. XIII)

Herba palustris circ. 40 cm alta. *Caulis* erectus, inferne crassiusculus, 5 mm diam, subangulatus et longe denudatus, superne 4-angulatus, siccitate sulcatus, ramosissimus; rami omnes floriferi, ascendentes, anguste 4-alati, alis minutissime serrulatis, simplices vel parce ramosi, plerumque opposito-decussati, aggregata corymbiformia conferta formantes. *Folia* caulina decussata, lanceolata, basi auriculata, auriculis rotundatis, acutiuscula, margine revoluta, circ. 30×10 mm, obscure pennivervia, nervo mediano supra impresso subtus prominenti; folia ramea eisdem caulium similia sed minora. *Dichasia* in axillis fere omnium foliorum, 2-7 (-pluri)-flora, usque 12 mm longa; pedicellus floris medii 4-gonus, plerumque circ. 8 mm longus, ad 2/3 bibracteolatus, bracteolis scariosis, anguste-linearibus vix 1 mm longis; pedicellus primi ordinis circ. 5 mm longus, paulo supra medium bibracteolatus; pedicellus secundi ordinis circ. 3 mm longus sub floribus bibracteolatus; pedicellus florium lateralium (si sunt) circ. 1 mm longus. *Flores* 4-meri. *Calyx* late campanulatus, 2 mm longus, 8-nervius, nervis prominentibus; lobi erecti, tubi circ. 1/3 aequantes; appendices minutae, sursum incurvae. *Petala* 4, lilacina (ex collect.), unguiculata, suborbicularia, 2,5×2,5 mm, apice leviter emarginata. *Stamina* 8, infra medium tubum inserta, sub anthesi exserta, episepala circ. 2 mm, lobos calycis superantia, epipetala tantum circ. 1 mm. *Ovarium* globosum, 1 mm longum; stylus 5 mm longus, stamina episepala circ. 1,5 mm superans (an flores trimorphi?). *Capsula* globosa, lobos calycis aequans. *Semina* minuta.

Fl. et fr.: Maj.

Habitat in *Moçambique*, Niassa distr., loco dicto *Amaramba*, in paludosis marginum fluminis *Mandimba*, 31-V-1948, *Pedro et Pedrógão* 4139 (COI, typus; LMJ).

Affinis N. stramineae Koehne (sect. Salicariastrum Koehne, series 2) a qua (ex descript.) habito robustiore (circ. 40 nec

10 cm), foliis longioribus et latioribus, dichasiis plurifloris, petalis minoribus, staminibus exsertis nec semiexsertis, capsulis calycem aequantibus nec superantibus, etc. differt.

Probabiliter affinis etiam N. Schinzii Koehne a qua habito erecto, foliis longioribus et latioribus basi dilatato-cordata nec subhastato-cordata, dichasiis 1-7 (-pluri)-floris nec 1-3 (-5)--floris, lobis calycis majoribus, staminibus (an flores dolichostyli?) exsertioribus, etc. differt.

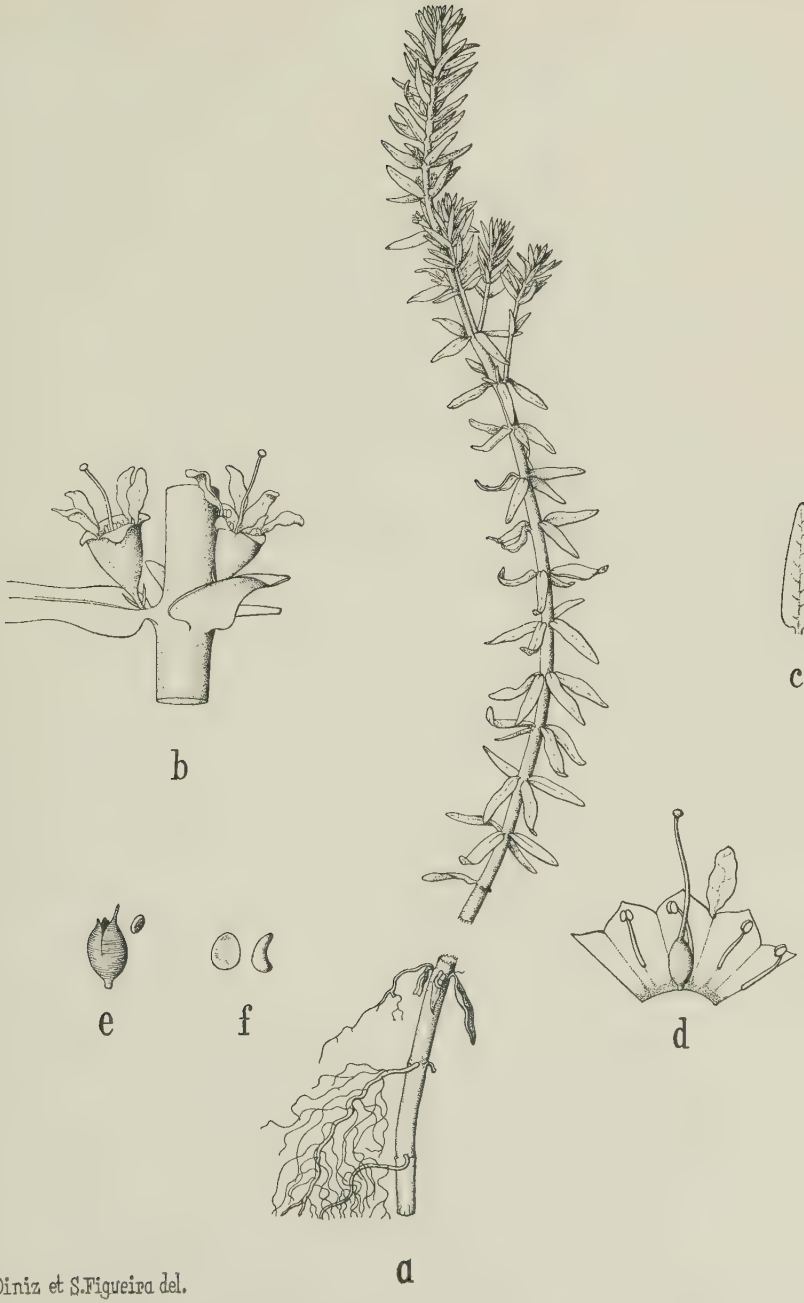
TABULAE

TABULA I

Rotala longicaulis A. Fernandes et A. Diniz

a — Habitus. × 1.
b — Rami pars cum floribus solitariis in axillis foliorum. × 5.
c — Folium. × 2.
d — Calyx explanatus. × 5.
e — Capsula dehiscens. × 5.
f — Semina. × 10.

(*Torre* 96)



A.Diniz et S.Figueira del.

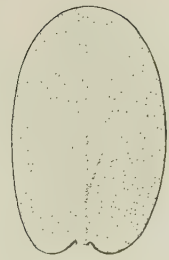
Rotala longicaulis A. Fernandes et A. Diniz

TABULA II

Rotala tetragonocalyx A. Fernandes et A. Diniz

a — Habitus. × 1.
b — Folium caulinum. × 1.
c — Folium rameum. × 2.
d — Calyx cum bracteolis. × 10.
e — Idem explanatus. × 10.
f — Calyx fructifer. × 10.
g — Capsula dehiscens. × 10.
g — Semina. × 10.

(*Exell et Mendonça* 2834)

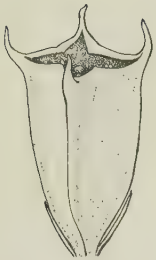


b

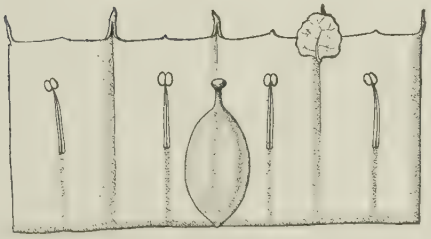
c

a

f



d



e

g

h

A.Diniz et S.Figueira del.

Rotala tetragonocalyx A. Fernandes et A. Diniz

TABULA III

Rotala congolensis A. Fernandes et A. Diniz

a — Habitus. × 1.
b — Rami apex cum floribus et alabastris. × 5.
c — Folium caulinum. × 2.
d — Folium rameum. × 2.
e — Flos cum bracteolis. × 15.
f — Calyx explanatus. × 15.
g — Ovarium cum stylo. × 15.
h — Calyx fructifer. × 15.
i — Capsula dehiscens. × 15.

(*Schmitz* 1684)

b

a

c

d

e

f

g

h

i

A.Diniz et S.Figueira del.

Rotala congolensis A. Fernandes et A. Diniz

TABULA IV

Rotala urundiensis A. Fernandes et A. Diniz

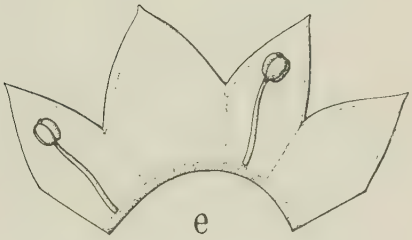
a — Habitus. × 2.
b — Folium caulinum. × 5.
c — Folium rameum. × 5.
d — Flos. × 15.
e — Calyx explanatus. × 15.
f — Ovarium cum stylo. × 15.
g — Calyx fructifer. × 15.
h — Capsula dehiscens. × 15.

(*Michel et Reed* 228)

a

f

d



e

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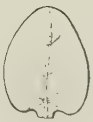
b



c

A.Diniz et S.Figueira del.

Rotala urundiensis A. Fernandes et A. Diniz

TABULA V

Rotala thymoides Exell var. **angustifolia** A. Fernandes et A. Diniz

a — Habitus. × 1.
b — Rami apex. × 3.
c — Folium caulinum. × 5.
d — Bractea. × 5.
e — Flos brachystylus cum bractea et bracteolis. × 5.
f — Idem dolichostylus. × 5.
g — Calyx floris brachystyli explanatus. × 5.
h — Calyx floris dolichostyli explanatus. × 5.

(*Antunes et Dekindt* 615)

A.Diniz et S.Figueira del.

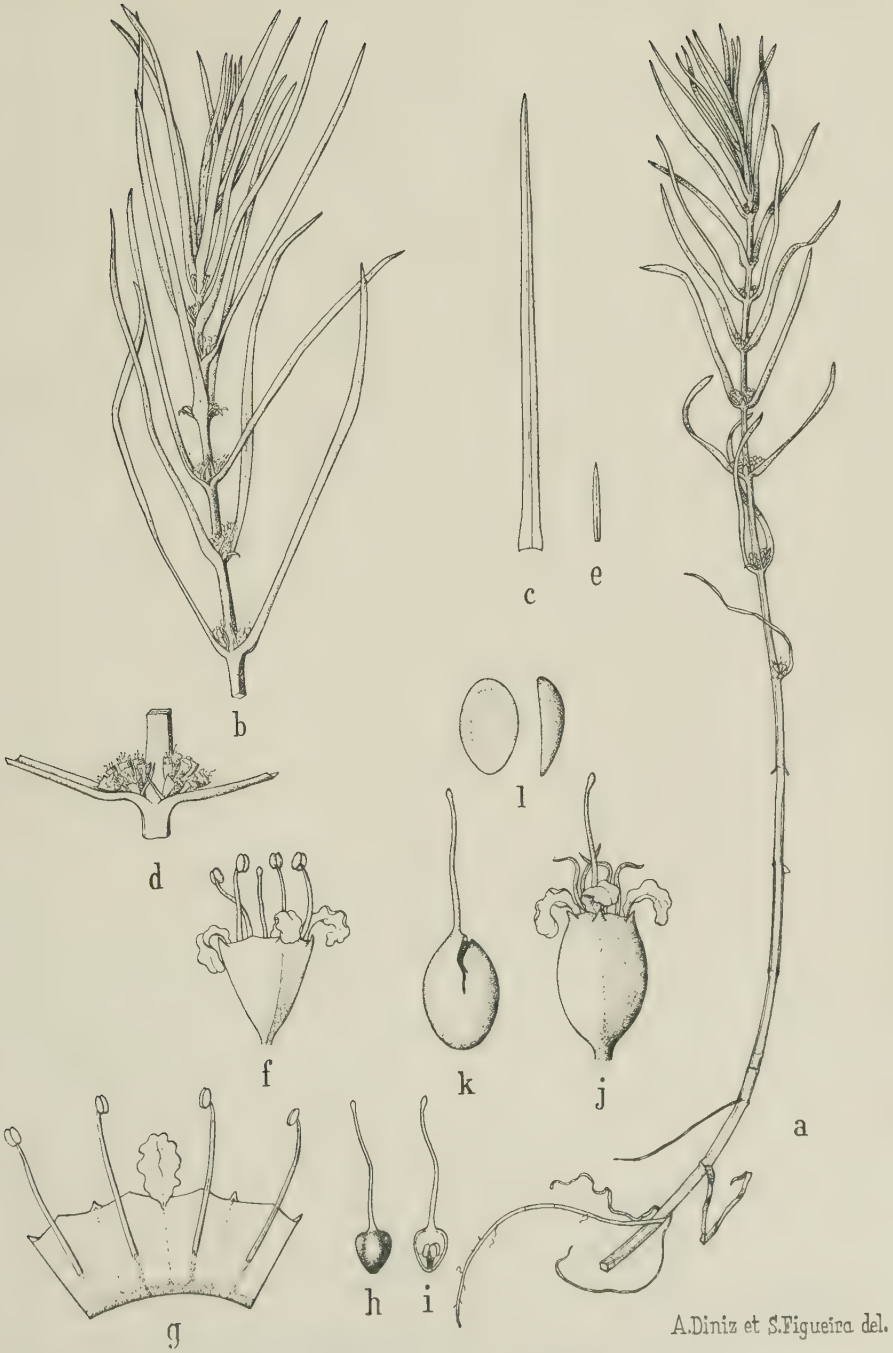
Rotala thymoides Exell var. **angustifolia** A. Fernandes et A. Diniz

TABULA VI

Hionanthera mossambicensis A. Fernandes et A. Diniz

a — Habitus. × 1/2.
b — Caulis apex. × 1.
c — Folium. × 1.
d — Caulis pars cum inflorescentiis. × 2.
e — Bracteola infima. × 4.
f — Flos. × 10.
g — Calyx explanatus. × 10.
h — Ovarium cum stylo. × 10.
i — Ovarii sectio longitudinalis. × 10.
j — Capsula calyci inclusa. × 10.
k — Capsula dehiscens. × 10.
l — Semina. × 10.

(*Torre* 719)



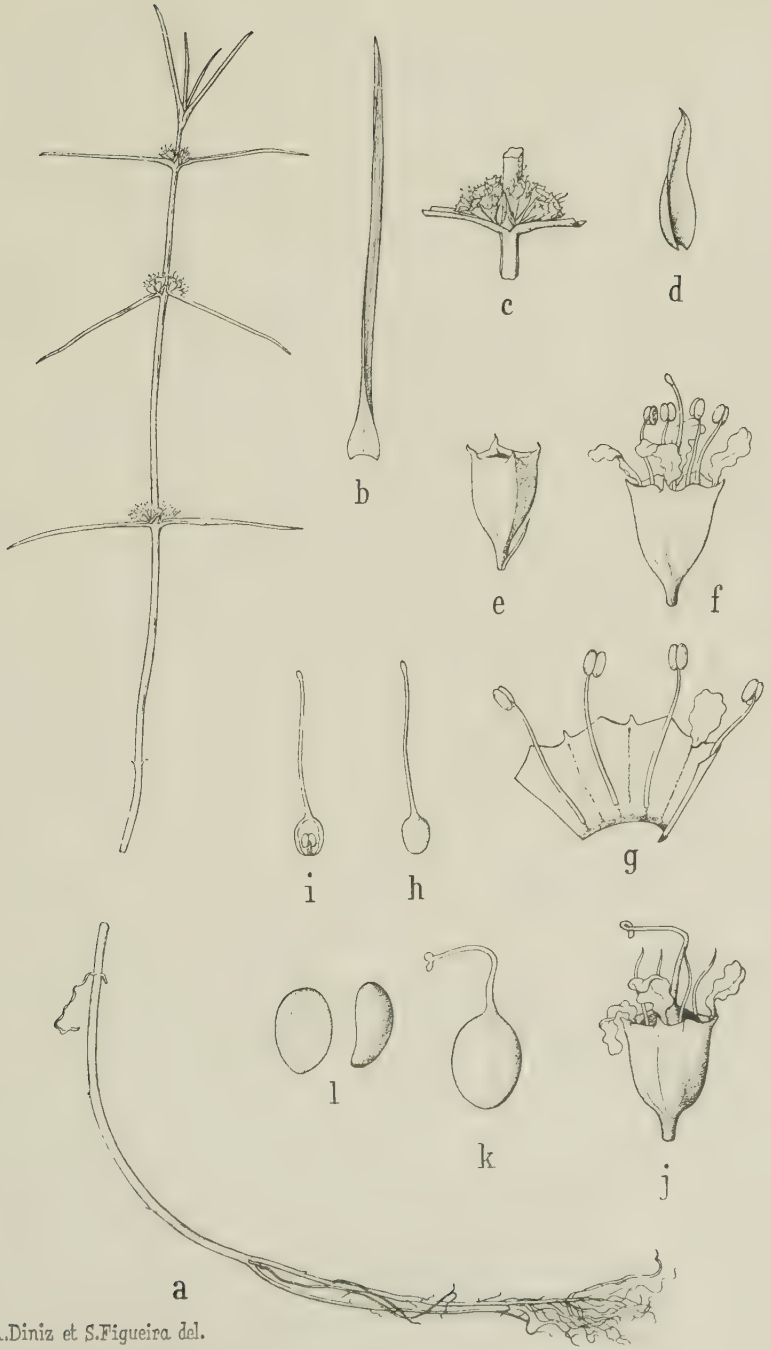
Hionanthera mossambicensis A. Fernandes et A. Diniz

TABULA VII

Hionanthera graminea A. Fernandes et A. Dinis

a — Habitus. × 1.
b — Folium. × 2.
c — Pars caulis cum dichasiis. × 3.
d — Bracteola primi ordinis. × 10.
e — Alabastrum cum bracteola. × 10.
f — Flos. × 10.
g — Calyx explanatus. × 10.
h — Ovarium cum stylo. × 10.
i — Ovarii sectio longitudinalis. × 10.
j — Calix fructifer. × 10.
k — Capsula. × 10.
l — Semina. × 10.

(*Torre* 715)



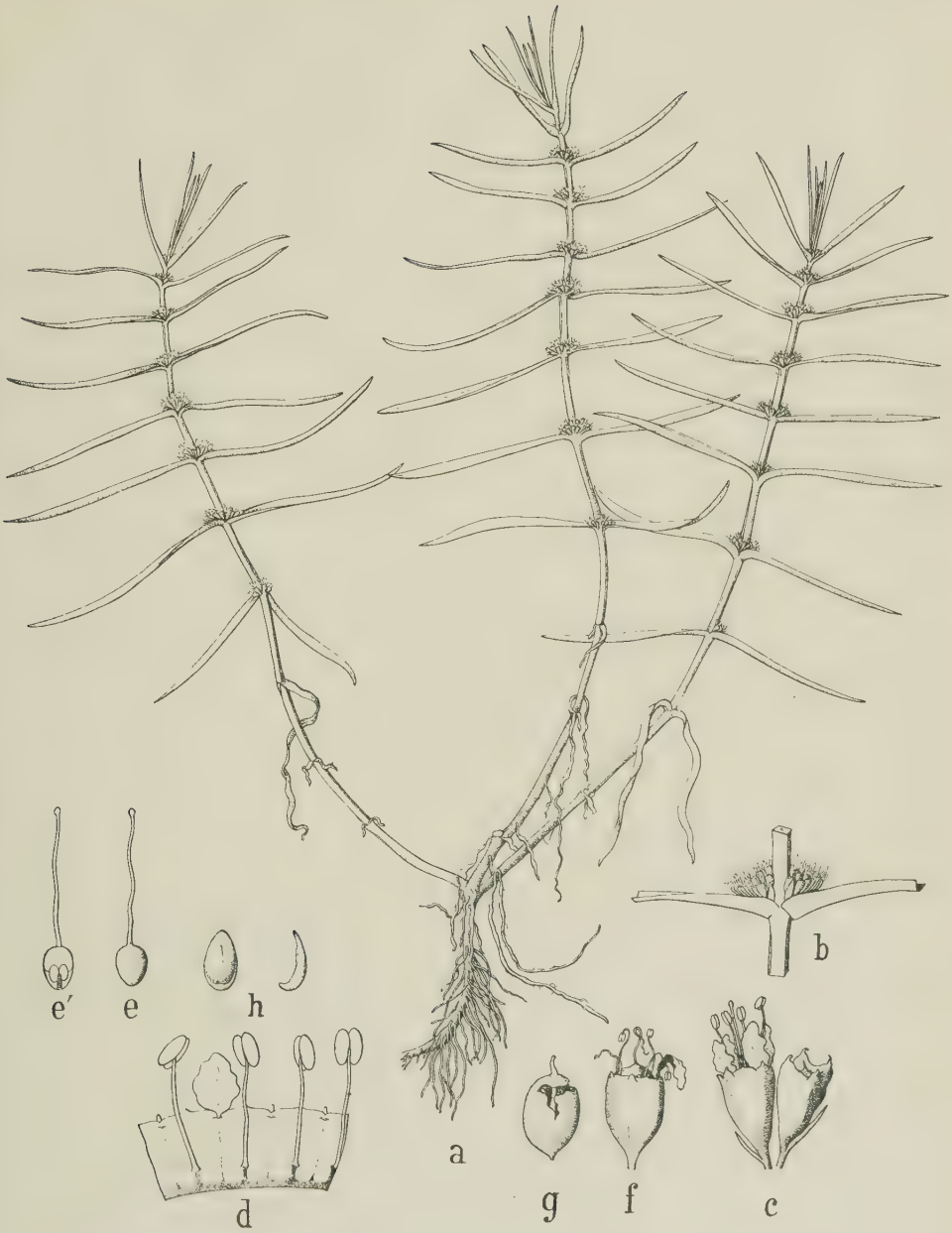
Hionanthera graminea A. Fernandes et A. Diniz

TABULA VIII

Hionanthera Torrei A. Fernandes et A. Diniz

a — Habitus. × 0,75.
b — Caulis pars cum dichasiis. × 2.
c — Flores cum bracteolis. × 7,5.
d — Calyx explanatus. × 7,5.
e — Ovarium cum stylo. × 7,5.
e' — Ovarii sectio longitudinalis. × 7,5.
f — Calix fructifer. × 7,5.
g — Capsula dehiscens. × 7,5.
h — Semina. × 7,5.

(*Torre* 1212)



A.Diniz et S.Figueira del.

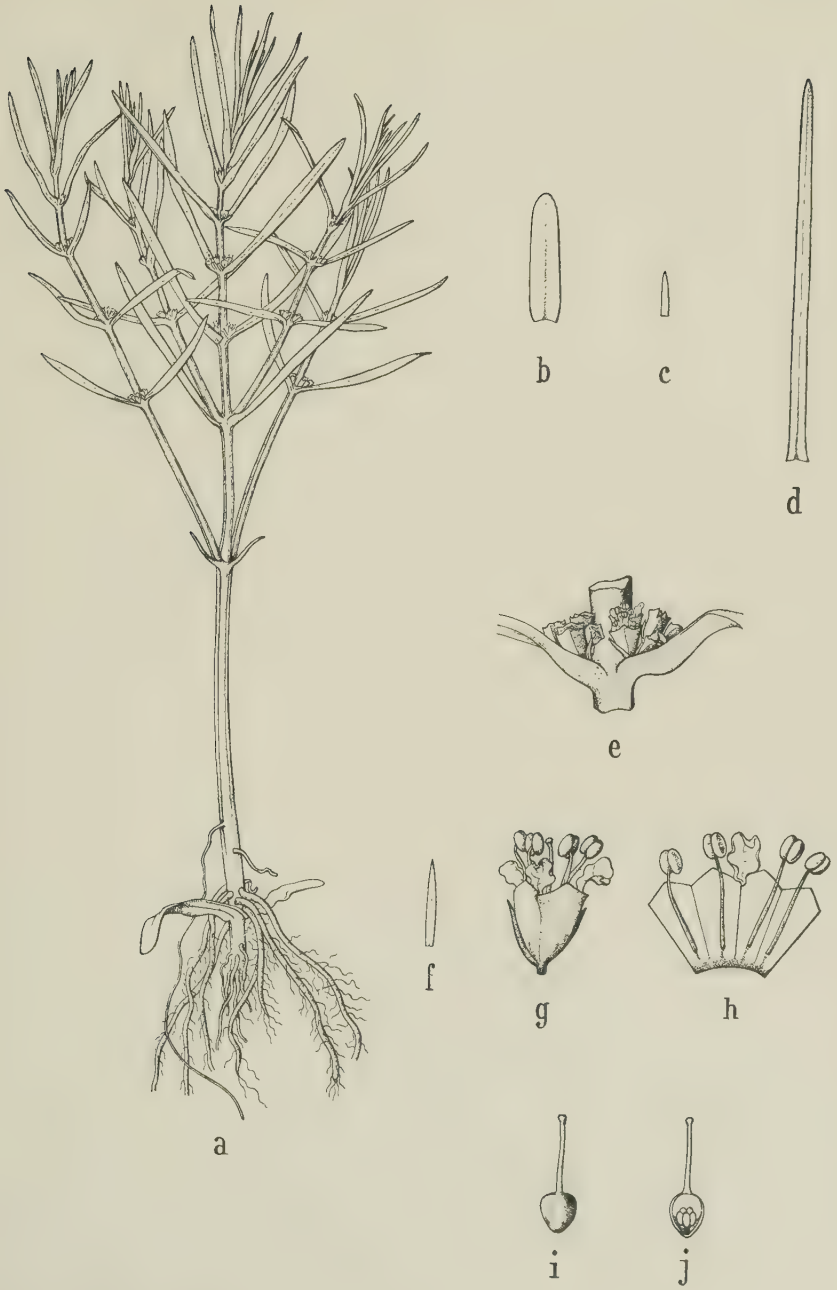
Hionanthera Torrei A. Fernandes et A. Diniz

TABULA IX

Hionanthera Garciae A. Fernandes et A. Diniz

a — Habitus. × 1.
b — Folium basis caulis. × 1.
c — Folium basis ramorum inferiorum. × 1.
d — Folium superum. × 2.
e — Pars caulis cum inflorescentiis. × 5.
f — Bracteola primi ordinis. × 10.
g — Flos cum bracteolis. × 10.
h — Calyx explanatus. × 10.
i — Ovarium cum stylo. × 10.
j — Ovarii sectio longitudinalis. × 10.

(*Garcia* 790)



A.Diniz et S.Figueira del.

Hionanthera Garciae A. Fernandes et A. Diniz

TABULA X

Nesaea angolensis A Fernandes et A. Diniz

a — Habitus. × 2.
b — Pars caulis cum dichasiis. × 4.
c — Folium inferum. × 4.
d — Folium superum. × 4.
e, f — Bracteolae. × 5.
g — Flos. × 10.
h — Calyx explanatus. × 10.
i — Calyx fructifer. × 10.
j — Capsula dehiscens. × 10.

(*Exell et Mendonça* 2748)

a

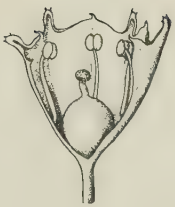
b

c

d

e f

g



h

i

j

A.Diniz et S.Figueira del.

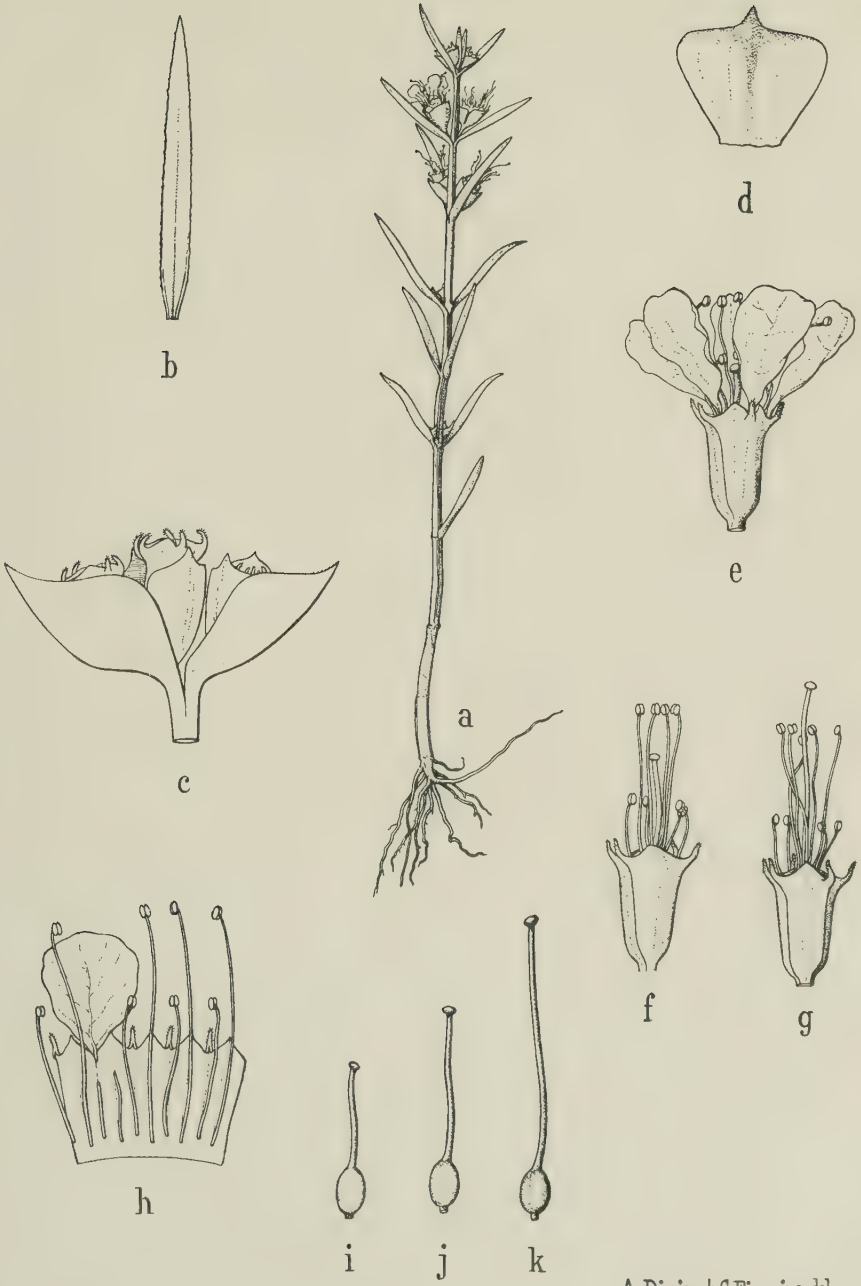
Nesaea angolensis A. Fernandes et A. Diniz

TABULA XI

Nesaea Pedroi A. Fernandes et A. Diniz

a — Habitus. × 1.
b — Folium. × 2,5.
c — Dichasium. × 5.
d — Bracteola primi ordinis. × 5.
e — Flos brachystylus. × 5.
f — Flos mesostylus post abscessionem petalorum. × 5.
g — Flos dolichostylus post abscessionem petalorum. × 5.
h — Calyx explanatus. × 5.
i — Ovarium floris brachystyli. × 5.
j — Idem mesostyli. × 5.
k — Idem dolichostyli. × 5.

(*Pedro et Pedrógão* 4523)



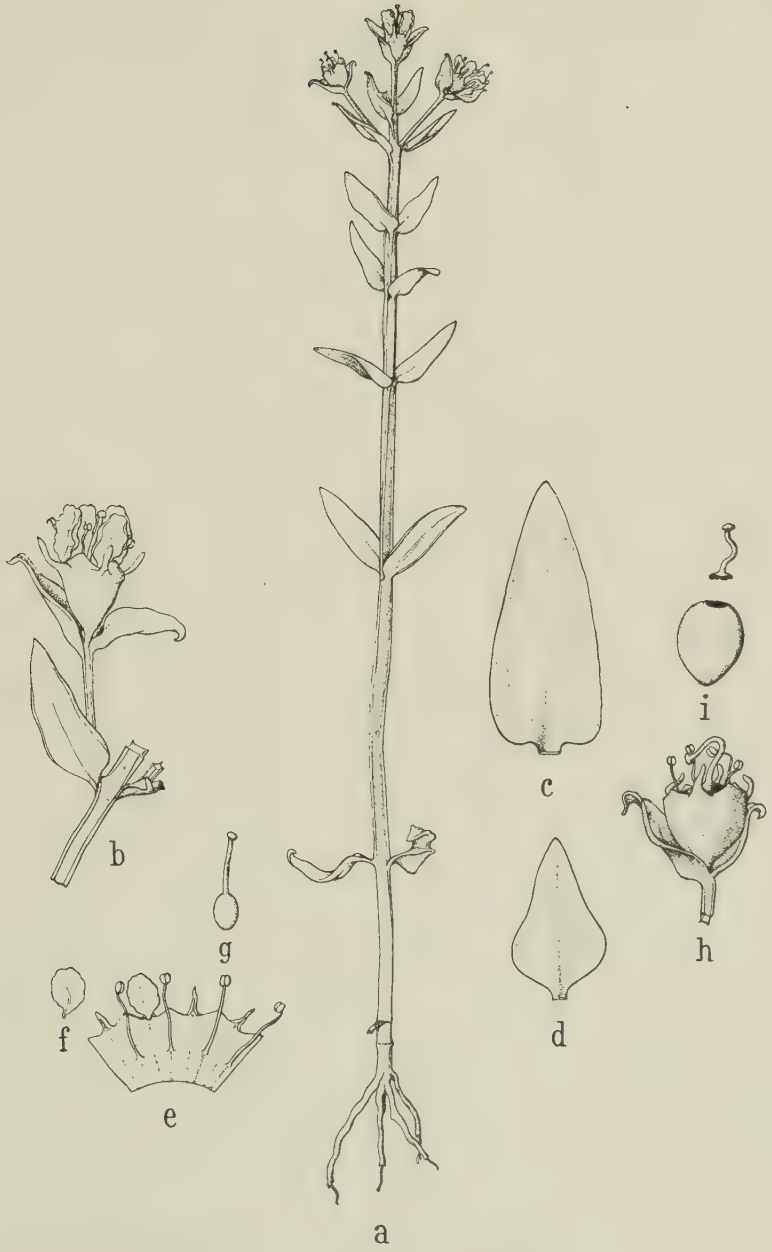
Nesaea Pedroi A. Fernandes et A. Diniz

TABULA XII

Nesaea pygmaea A. Fernandes et A. Diniz

a — Habitus. × 3.
b — Caulis pars cum inflorescentia. × 6.
c — Folium. × 6.
d — Bracteola. × 10.
e — Calyx explanatus. × 6.
f — Petalum. × 6.
g — Ovarium cum stylo. × 6.
h — Calyx fructifer cum bracteolis. × 6.
i — Capsula dehiscens. × 6.

(*Torre* 1365)



A.Diniz et S.Figueira del.

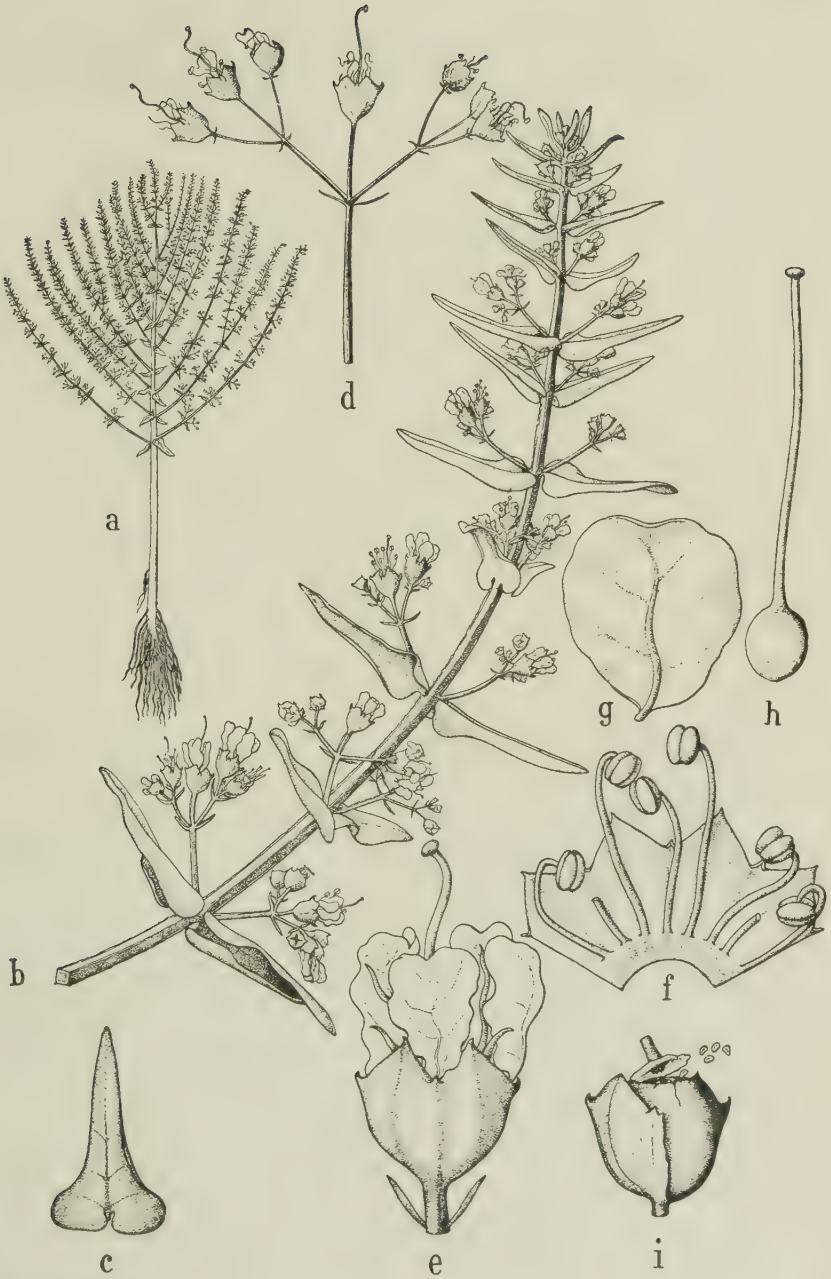
Nesaea pygmaea A. Fernandes et A. Diniz

TABULA XIII

Nesaea ramosissima A. Fernandes et A. Diniz

a — Habitus. × 1/6.
b — Rami pars superior. × 2.
c — Folium. × 2.
d — Dichasium. × 4.
e — Flos cum bracteolis. × 10.
f — Calyx explanatus. × 10.
g — Petalum. × 10.
h — Ovarium cum stylo. × 10.
i — Capsula dehiscens. × 10.

(*Pedro et Pedrógão* 4139)



A.Diniz et S.Figueira del.

Nesaea ramosissima A. Fernandes et A. Diniz

INDUCTION OF CHROMOSOME BREAKAGE WITH BACTERIAL PRODUCTS

THE ORIGIN OF MUTATIONS

by

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Botanical Institute, University of Coimbra, Portugal

1. INTRODUCTION

CHROMOSOME breakage is a fundamental factor in biology. It is connected with gene mutation, structural changes in the chromosomes and crossing-over, all of which are basic factors in the evolution of plants and animals. Furthermore the experimental chromosome breakage with ionizing radiations and chemicals revealed a useful instrument in the analysis of chromosome structure and proprieties. Finally the production of chromosome breakage, by its lethal consequences, is the most effective experimental agent in the death of cells and because of that it is an important factor in cancer therapy.

The discovery that X-rays produce mutations, i. e., permanent changes in the genes (MULLER, 1927) was followed by the discovery that it can produce structural changes in the chromosomes (STERN, 1929). After this a great deal of work has been done in the study of ionizing radiations actions not only with animals but also with plants (see LEA, 1946).

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(1) Bolseiro do Instituto de Alta Cultura.

When the mutagenic effects of radiations on genes and chromosomes were demonstrated, investigations started to produce mutations by chemical agents. But only relatively and quite recently this was attained. As a matter of fact the first successful attempt to produce mutations (genic and structural) must be attributed to AUERBACH and ROBSON (1942, 1946) who found that mustard gas ($\beta\beta'$-dichloro-diethyl-sulphide) was able to induce mutations in *Drosophila*. Coincident with this discovery were the positive results of OEHLKERS (1943) who, using a mixture of ethylurethane and potassium chloride, obtained translocations in the meiotic chromosomes of *Oenothera* and *Campanula*. The first detailed description of the cytological effects of the mustard gas was published by DARLINGTON and KOLLER (1947). The mustard gas was found to be very effective as inducer of chromosome breaks. As the genetical and cytological effects of mustards are very similar to those produced by X-rays, the mustards come to be known as chemical agents with radiomimetic effects.

As a result of investigations made during the last few years, it is apparent that a great number of chemicals are able to induce chromosome breaks. The active chemicals are both inorganic and organic compounds. The following list is only a partial one: bromine (CHURY and SLOUKA, 1949); aluminium chloride (OEHLKERS, 1943; DEUFEL, 1951); diallyldisulphide (HOFFMANN-OSTENHOF and KECK, 1951); Putrescin-hydrochloride (MARQUARDT, 1949 *a*); phenols (LEVAN and TJIO, 1948); acenaphtene (D'AMATO, 1949); naphtalene derivatives (AVANZI, M. 1950, AVANZI, S. 1954); acridine derivatives (BAUCH, 1947; D'AMATO, 1950, 1951; D'AMATO and AVANZI, 1954); maleic hydrazide (DARLINGTON and MCLEISH, 1951); purine derivatives (KIHLMAN and LEVAN, 1949; KIHLMAN, 1950 *a*, *b*, 1952); antibiotics (LEVAN and TJIO, 1951; TANAKA and SATÖ, 1952); coumarin derivatives (D'AMATO and AVANZI, 1954); plant hormones (SHARMA and MOOKERJEAE, 1954).

In 1933 NAVASCHIN noted that *Crepis tectorum* L. seeds with 9 and 7 years showed a greater percentage of chromosome aberrations than young ones. Based on this fact many workers have been looking to demonstrate by using aged seeds (and other organs) extracts, that with time mutagenic substances

are there acummulated. In connetion with this, MARQUARDT (1949 *a, b,* 1950) used water extracts from 10 years old *Oenothera* seeds on meiosis in *Paeonia tenuifolia;* KECK and HOFFMANN-OSTENHOF (1951) water extracts from 1 and 5 years old seeds of *Phaseolus vulgaris* in root meristems of *Allium Cepa;* GISQUET, HITIER, IZARD and MOUNAT (1951) extracts of aged Tobacco seeds on Tobacco seedlings; KECK and HOFFMANN-OSTENHOF (1951) extracts of onion bulbs in *Allium Cepa;* RESENDE (1951) extracts of *Urginea maritima* bulbs, seeds of *Hyoscyamus niger* and old dry scales of *Allium Cepa* bulbs in root meristems of *Allium Cepa;* MOTA (1952) extracts from barley seeds (1 and 7 years old) in root meristems of *Allium Cepa;* SCARASCIA and SCARASCIA (1954) extracts of aged seeds of *Soja hispida* in root meristems of *Allium Cepa.*

The findings of the above authors seem to show that sometimes the extracts can have a mutagenic action, but taking in the account the conditions in which they are made — without asepsis — can be subjected to a strong criticism as we will see below.

In the present work it is observed that bacterial products have a mutagenic action, inducing structural changes in the chromosomes of the root tip of *Vicia faba.* This finding has the following history: DERMEN (1954) was able to induce polyploidy in grapes with a solution of 0,5 % colchicine in 10 % glycerine in water. Glycerine was used to provide a non-volatil medium. The same author concludes that «higher percentage of glycerine are injurious to many plants». For the purpose of verifing the possible injurious effects with glycerine on mitosis we added to a solution of 0,05 % colchicine in water 10 % glycerine. The colchicine solution used was an aged one, which had been utilized several times to excised root tips and because of this countained manifestly organic matter (of unknown composition, of course). Besides that it was added to that solution traces (about 0,002 %) of a growth substance, β-naphthoxy-acetic acid. It means thus that our solution countained: colchicine + β-naphthoxy-acetic acid + glycerine + organic matter. Within this solution we placed two excised root tips of *Vicia faba* where they rest 10 hours. After this they were squashed in acetic-orcein. An outstanding phenomenon was then obser-

ved: the chromosomes of a large proportion (about 70 %) of cells showed various structural changes, mainly translocations.

The first hypothesis that occurred to us it was that some of the known substances present in the solution was the agent of such phenomenon. But the action of glycerine and that of β-naphthoxy-acetic acid (colchicine is well known not to be mutagenic) tested separatly showed none mutagenic action. Glycerine in 10 % in water was found not affecting mitosis which is in accordance with OSTERGREN's observations (1944). The plant hormone β-naphthoxy-acetic acid likely did not show mutagenic action. Similar to LEVAN's (1949) and SHARM's (1954) observations it was verified to have C-mitotic effects. A further test was made with a solution containing the three substances (colchicine, β-naphthoxy-acetic acid and glycerine) to verify if its interaction would have mutagenic effects. The results were however negative.

In regard of the above data another hypothesis was considered: that the organic matter present in the solution was the cause, possibly by being contaminated by bacteria. The hypothesis of bacterial contamination was confirmed because we were able to isolate a mixed bacterial population consisting in gram-positive and gram-negative bacteria. This mixed bacterial population was afterwards cultivated in meat broth. In this medium (after 48 hours incubation) root tips (not excised) were immersed during a measured time. It was observed that such a treatment induced a large proportion of structural changes in the chromosomes. Undoubtly the conditions in this experiment were different from those inicially present in the first solution. Now we have mixed bacteria (we are studing the determination of its bioquimism) growing in a known organic matter, i. e., proteins. In order to eliminate the varing factor, mixed bacteria of unknown metabolism, a further experiment was made using a pure culture of a bacteria of known metabolism: *Bacillus Proteus*. The choice of this bacteria was not made at chance but having in mind the observations of MARQUARDT (1949 *a*) who, using putrescin-hydrochlorid, was able to induce chromosome breakage in *Oenothera*. As it is known, *Bacillus Proteus* in decaying of proteins produces the putrescine amine. We expected then, that its culture in broth meat would be mutagenic.

In fact our expectation was fully confirmed. Certainly this does not prove that putrescine is the responsible substance for mutagenic action in such cultural medium, because of its chemical complexity, although this is a tentative hypothesis.

The general conclusion that emerges from these data is that although the conditions in these different experiments were different and therefore were also different substance or substances with mutagenic action we can, however, conclude that are in action products resulting from bacterial activities, i. e., the decomposition of organic matter (mainly proteins) by bacteria gives rise to products that are highly mutagenic. This was further confirmed by an experiment conducted in aseptical conditions where it was verified that steril meat broth, i. e., undecomposed proteins, had no mutagenic action whatever.

In connection with experiments of those authors who used extracts of seeds or other organs, as supposed mutagens, it is important to note that for them the varing factor, bacterial contamination, has not been taken in consideration. This undoubtly is now apparent to introduce a source of error in the interpretation of theirs results.

Some of the induced chromosome structural changes are symmetrical interchanges (reciprocal translocations) between non-homologous chromosomes, and small delections. In some cells this is the only event that can be seen, that is, the cell can overcome the anaphase test. Taking in account that the phenomena of reciprocal translocation and of delection were postulated and demonstrated to be of evolucionary significance in plants, some speculations are made on the possible role of bacterial products existing naturaly in the soil being one of the causes of spontaneous mutations in Nature. Finally some considerations are made about two related problems: crossing-over and cancer.

2. MATERIALS AND METHODS

Vicia faba ($2n = 12$) was used for all the experiments. Seeds aged 1 year were soaked in tap water during 12 hours. Following this they were germinated on moist filter paper in Petri dishes at room temperature (20°-25° C). When the primary roots were approximately 3 cm. long, treatment with

bacterial products was given. The treatment consisted simply in the immersion of the root tips in the liquid cultural medium of the bacteria (after incubation for 48-72 hours at 25° C) for a measured time. The standard treatment time was 6 and 12 hours, at the end of which the roots were thoroughly washed. Thereafter the roottips were pre-treated for 4-24 hours in 0,05 % colchicine.

They were then prepared as acetic-orcein squashes (La Cour, 1941) without previous fixation, and mounted in Euparal. By this technique extremely beautiful metaphase plates were met with in abundance.

Controles — Two series of controles were made:

In one group the root tips were not treated with bacterial products. All the others mentioned above conditions were maintained. In the other group the root tipe were submitted, in aseptic conditions, to a treatment with sterile broth meat. Sterile seedling roots were obtained by surface sterilisation of seeds with hypochlorite solution (Gautheret, 1935) followed by germination in sterile Petri dishes.

In these two control series, as it was expected, no structural changes in the chromosomes were found.

3. CYTOLOGICAL OBSERVATIONS

The normal chromosomes of Vicia faba

To be able to perform a qualitative study of the localization of the chromosome breaks, the morphology of the chromosomes must be known. The 12 somatic chromosomes of *Vicia faba* are well known. Using the 8-oxyquinoline technique, Tjio and Levan (1950) were able to distinguish all the 6 pairs of chromosomes at metaphase and propose the following key to their determination:

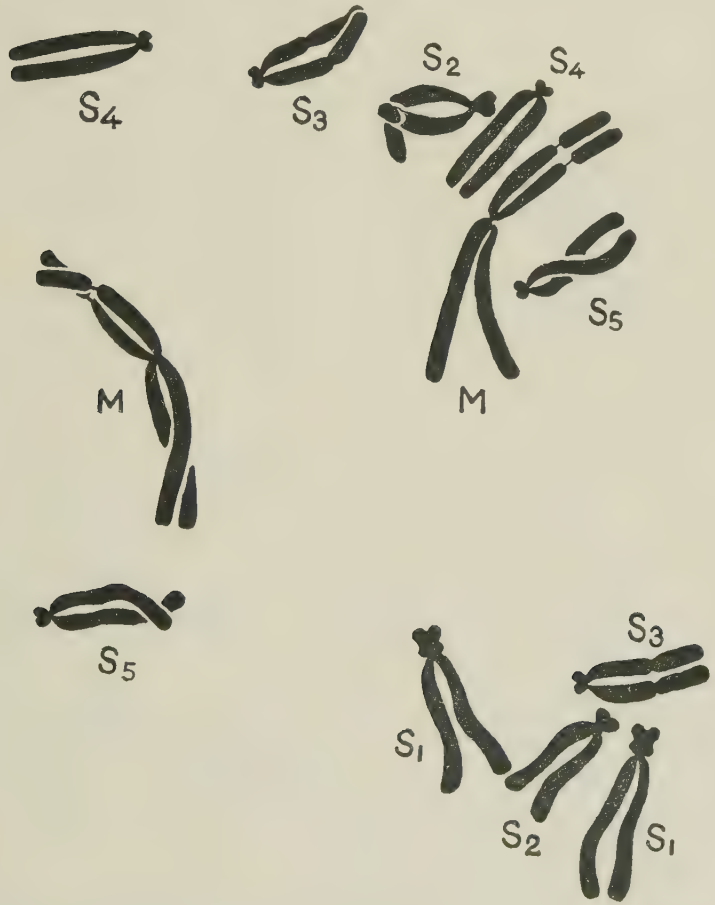
1. Centromere submedian
   Biggest pair, big satellite on short arm ..... I (M)

2. Centromere subterminal
   11. Head only little shorter than chromosome breadth
      21. Head made up of two parts ..... II (S_1)
      22. Head single

31. Long arm without secondary constriction .... III (S_2)
32. Long arm with secondary constriction ..... IV (S_3)

12. Head decidelly smaller than chromosome breadth

41. Longer pair ..... V (S_4)
42. Shorter pair..... VI (S_5)



Text-fig. I — The 12 chromosomes of *Vicia faba* (see also Plate I, fig. 1). × 2.700.

In the present work the material was pre-treated with 0,05 % colchicine which equally, or even better than 8-oxyquinoline, gives beautiful preparations.

The symbols that we attributed to the chromosomes are M and S_1-S_5 respectively (see text fig. 1 and Pl. I, fig. 1).

Physiological effects

The acetic-orcein squash technique can induce, due mainly to the heating not been controled, artifacts on the surface of chromosomes. And it can even produce fragmentation of chromosomes as it was demonstrated very recently by SHARMA (1955). Besides that we have to consider the particular effects of colchicine pre-treatment. Having all this in mind we avoid in this work to speak of physiological effects such as « chromatic agglutination », « lampbrush appearance », chromosome « stickiness » and « erosion », etc. Undoubtly many times those effects considered by authors as *physiological*, they are not more than artifacts produced by the techniques.

The only fact that can be mentioned, is, perhaps, the pronounced relational coiling of chromatids at prophase (see Pl. I, fig. 2).

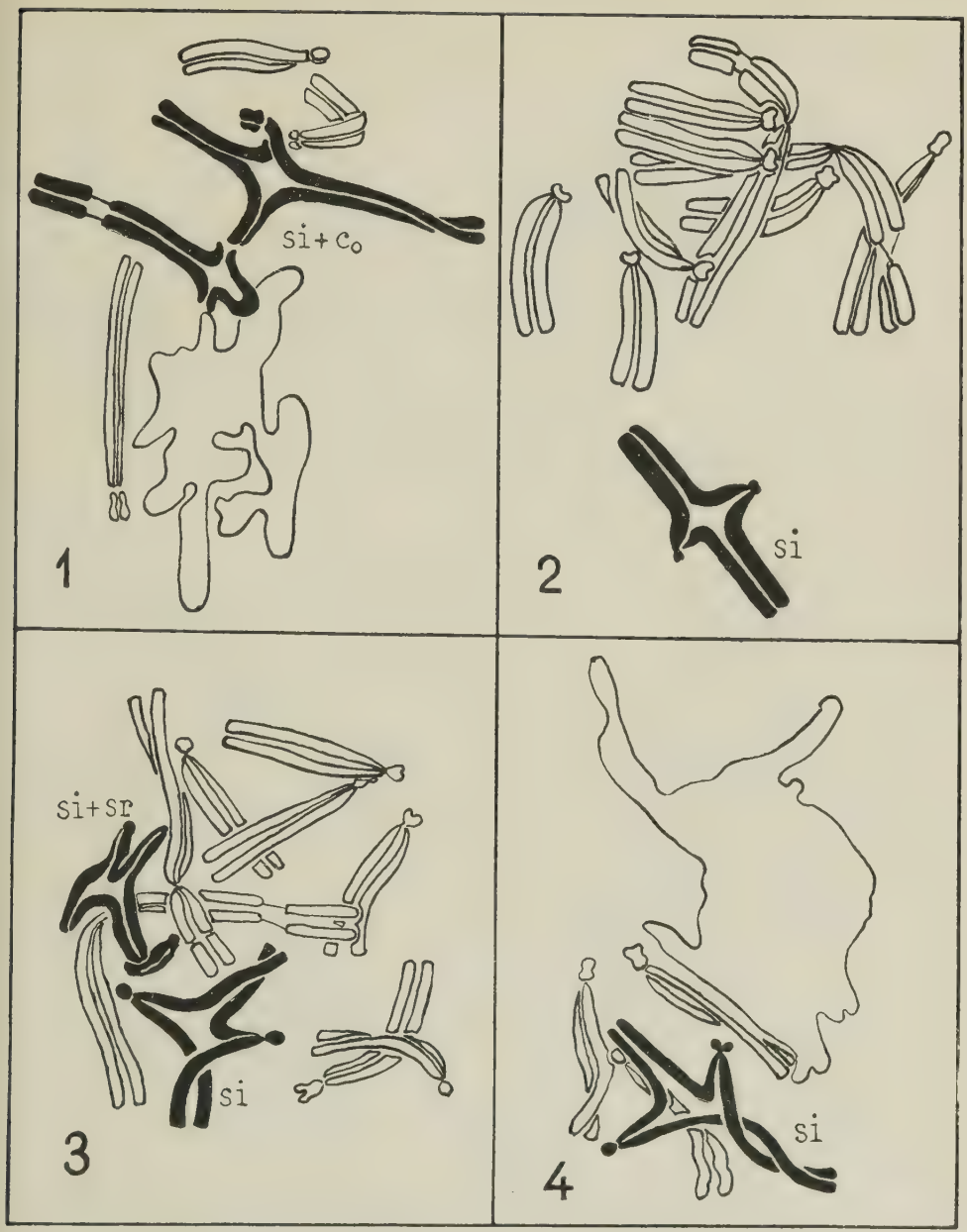
Chromosome structural changes

All the structural changes were scored at metaphase. We took the metaphase stage, firstly, because the reciprocal translocations (symmetrical interchanges) are of highest evolutionary significance and can not be detected at anaphase; secondly, because the observations classified simply as abnormal anaphases, i. e., bridges and fragments, yield much less information.

Structural changes were scored at the metaphase next ensuing after treatment (X_1); in one case, however, the structural change was scored at the second mitosis after treatment (X_2) (Pl. IX); in another case a reciprocal translocation was detected at X_1 prophase (Pl. II, fig. 1).

The data are formally treated according to the following terminology (see DARLINGTON and UPCOTT, 1941; Lea, 1946):

SR — sister-reunion
s. i. — symmetrical interchange (reciprocal translocation)
a. i. — asymmetrical interchange
Co — acentric fragment



Text-fig. II — 1, Symmetrical interchange between S_1 - M (?) chromosomes; the nucleolar arm of one M chromosome is broken (see Pl. VII, fig. 3). 2, Symmetrical interchange between two S homologous chromosomes. Only 11 chromosomes can be counted (the squash threw out of cell one of them) (see Pl. VIII, fig. 3). 3, Symmetrical interchange between two S homologous chromosomes, and symmetrical interchange between two S chromosomes, with SR (see Pl. II, fig. 2). 4, Symmetrical interchange between two S non-homologous chromosomes (see Pl. II, fig. 3).

1, 3, 4, $\times$ 2.200; 2, $\times$ 2.500.

C_1 — centric fragment
m — minute
C_2 — dicentric chromosome

The analysis of our slides revealed:

a) *Sister-reunion* (SR)

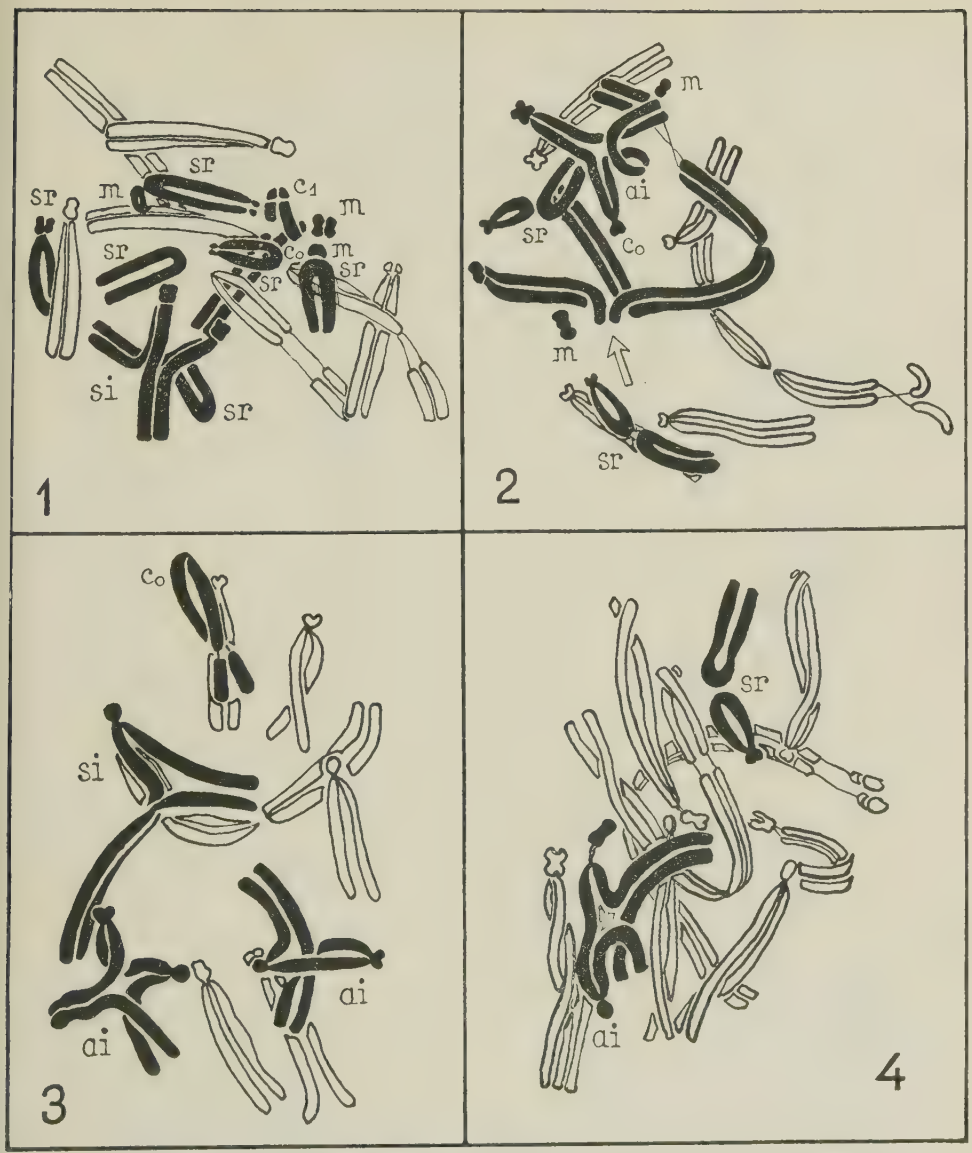
This occurs with a certain frequence. The chromosomes that are more affected are the S chromosomes (see for example Pl. III, fig. 1; Pl. IV, fig. 4; Pl. VI, fig. 2). The breaks are mainly median in position. Only in rare cases the M chromosomes show SR (text-fig. III, 3; text-fig. IV, 3).

b) *Symmetrical interchanges* (s.i.)

As is well known this structural change does not gives rise neither to bridges nor to fragments at anaphase. The chromatids that interchange are homologous (see, for example, Pl. II, fig. 2; Pl. III, fig. 2; Pl. VIII, fig. 3) or non-homologous (Pl. III, fig. 1; Pl. V, fig. 1; Pl. VIII, fig. 1). An interesting case of non-homologous chromatid interchange is that observed in Pl. VII, fig. 1, 1' (s.i.). By this process two new types of viable chromosomes are originated (see text-fig. VIII). In one cell it was possible to detecte at prophase a symmetrical interchange between two S chromosomes (Pl. II, fig. 1, 1'). It was not observed, even in one case, symmetrical interchange between M chromosomes. However, it is known that this occurs in *Vicia*, for example after maleic hydrazide treatment (Mc Leish, 1953) or diepoxide (Revell, 1953). The configurations resulting from symmetrical interchange fall into two classes in regard to centromere coorientation: one resembles meiotic bivalents at diakinesis, the other are chiasma-like configurations (see text-fig. IX, respectively row A and B).

c) *Asymmetrical interchanges* (a.i.)

This type of structural change gives rise in anaphase to bridges and fragments. The chromatids that interchange are either homologous (for example Pl. VI, fig. 2) or non-homologous (Pl. V, fig. 2 and fig. 4; Pl. IV, fig. 2 and fig. 4; Pl. VI, fig. 1). A clearly example of a. i. between two S



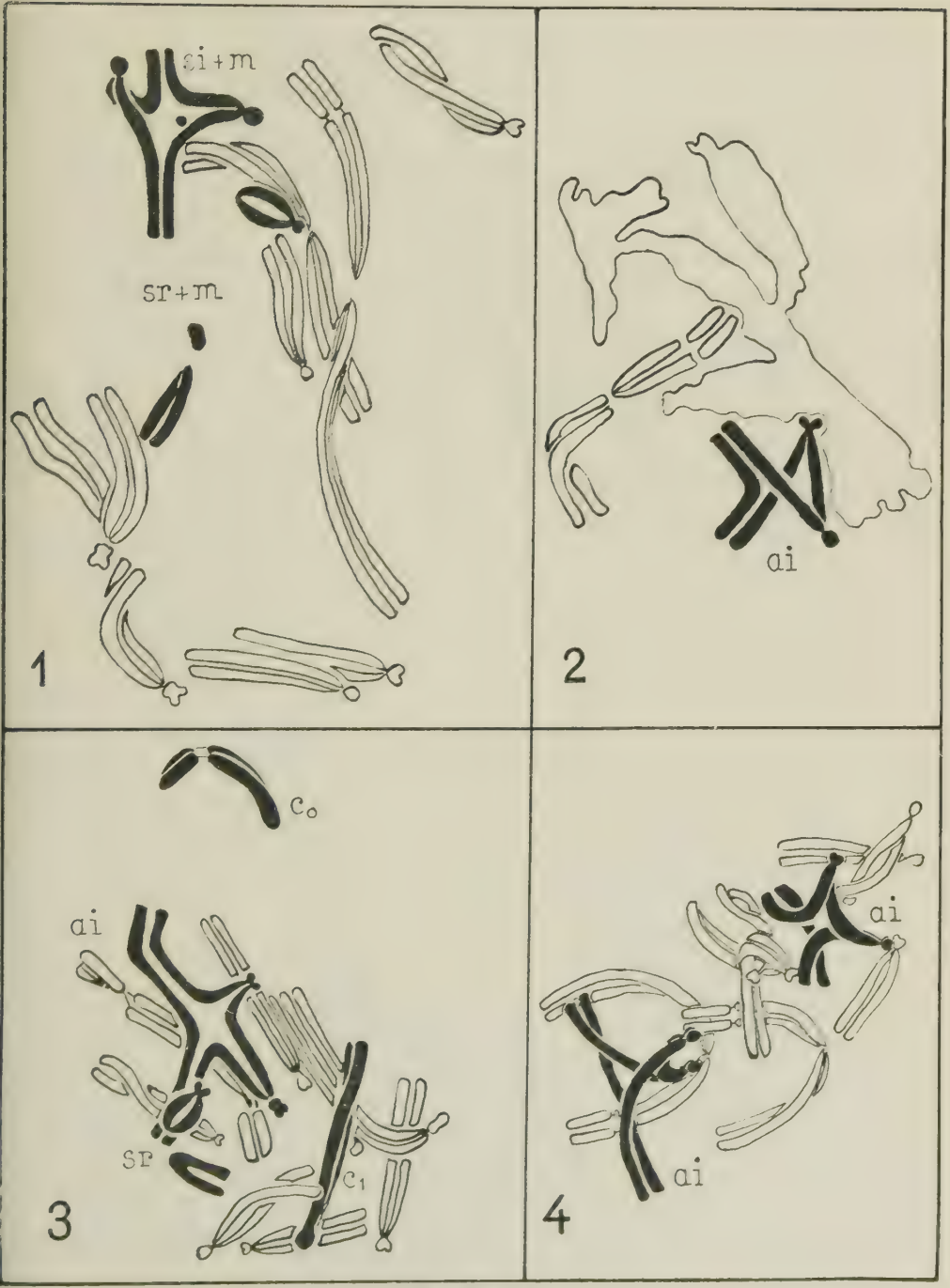
Text-fig. III—1, Symmetrical interchange between two S chromosomes; breakage in 5 S chromosomes followed by SR; two minutes (m) originated by breakage at the centromere (see Pl. IV, fig. 1). 2, S_1-S asymmetrical interchange (ai); breakage in 3 S chromosomes followed by SR; simulated pairing of non-homologous chromatids (arrow) (see Pl. IV, fig. 2). 3, Breakage close to the centromere of the M chromosome giving rise to the Co acentric fragment, followed by interchange (read ai instead of si) with an S chromosome; two S-S asymmetrical interchanges (ai) (see Pl. IV, fig. 3). 4. SR in a S chromosome; asymmetrical interchange between S_1-S chromosomes (ai) (see Pl. IV, fig. 4). $\times$ 2.200.

non-homologous chromosomes is Pl. VI, fig. 3. In this same Plate, fig. 4, shows a.i. between two S chromosomes, but the resulting acentric fragment laid outside. An example of M-S asymmetrical interchange is Pl. VII, fig. 2, and 2'. An interesting fact is the simultaneous interchange among three chromosomes, two S and one M chromosome (Pl. VIII, fig. 1 and 1'). This is clearly a case of simultaneous s.i. + a.i. that leads to a bridge, a fragment, and two new functional chromosomes (see text-fig. VII). In one of the chromatids can be noted a gap localised in the same point where translocation took place. We can think in two hypothesis to explain this, based in the pairing forces of homologous chromatids: first, reunion did not take place; second, reunion was secondary delected.

d) *Small delections (minutes)*

These are seen either as terminal or intercalary delections. In Pl. IV, fig. 2 (arrow) it can be seen that a chromatid of a S chromosome and a chromatid of a M chromosome underwent a small terminal delection. These minutes are clearly seen at left hand. But, very interesting the two unbroken chromatids simulate to be paired (see arrow). We can explain this apparent pairing as a consequence of the forces originated by the two broken ends in movement to attain reunion. A special case that we classified also as minutes arises when the S chromosomes are broken apparently at the centromere. This gives rise to a minute correspondent to the shorter arm of the S chromosome (text-fig. III, fig. 1, m). In some symmetrical interchanges, a minute of intercalary type is clearly seen lying perhaps where it arose, i.e., at the point of breakage of chromatids [Pl. III, fig. 2 and 2' (s.i. + m); Pl. V, fig. 1 and text-fig. IV, fig. 1 (s.i. + m]. In this same cell of Pl. V,

Text-fig. IV — 1, Symmetrical interchange between two S non-homologous chromosomes, with a minute apparently localised at the point of breakage; one S chromosome shows sister reunion and intercalary delection (see Pl. V, fig. 1). 2, Asymmetrical interchange between two S chromosomes (see Pl. V, fig. 2). 3, Asymmetrical interchange between two S non-homologous chromosomes; one S chromosome shows sister reunion; one M chromosome is broken at the centromere region (C_1); the acentric (Co) carries two nucleolar organisers (see Pl. V, fig. 3). 4, Two asymmetrical interchanges (ai) between S chromosomes (see Pl. V, fig. 4) $\times$ 2.200.



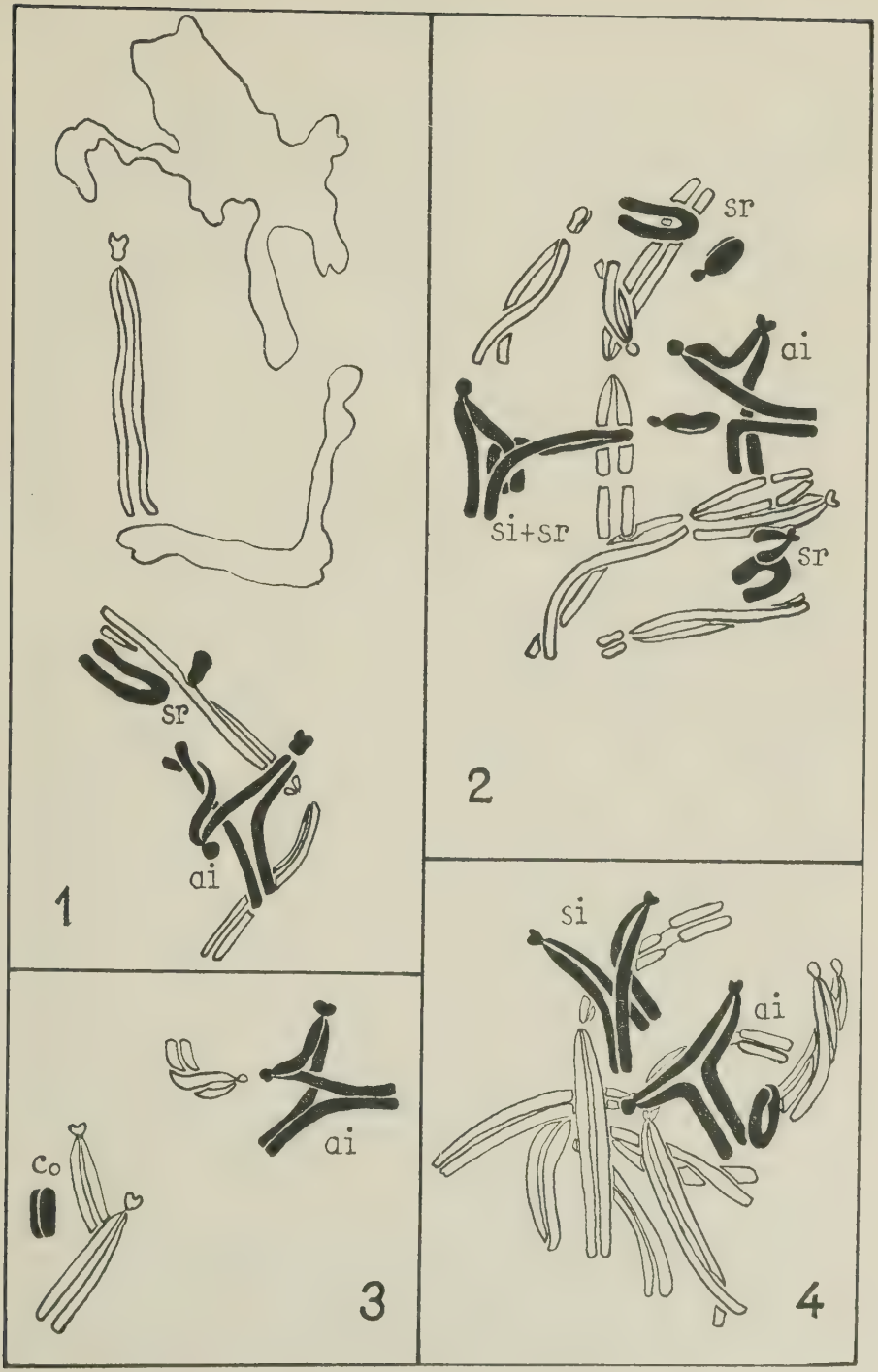
Text-fig. IV

fig. 1, an S chromosome that shows SR has suffered an intercalary delection (sr + m). In the cell shown in Pl. III, fig. 2 and 2', a somewhat puzzling phenomenon is presented. As is clearly seen (arrow), one of the chromatids of the nucleolar arm of one M chromosome does not show the nucleolar constriction. Asymmetry in the satellites is well known in plant cytology. As RESENDE (1938) says «the absence of satellites in one of the partners, the difference in size of the satellites and of the SAT-thread and the different position of the satellites in both partners, led to establish asymmetry in the satellites». And the same author assumes that all asymmetries can be explained by chromosome mutations, i. e., «transformation, delection, translocation and shortening of the thread». However, in our case a shortening of the thread is not admissible because the lenght of nucleolar chromatid is not changed. Further, a careful analysis of all the chromosomes of this cell, does not revealed that a nucleolar chromatid has taken part in any structural change (chromosome mutation). The most suggestive hypothesis is that the origin of asymmetry lies in the characteristic lability of the nucleolar zones (RESENDE et al. 1944; FERNANDES, 1951 *b*).

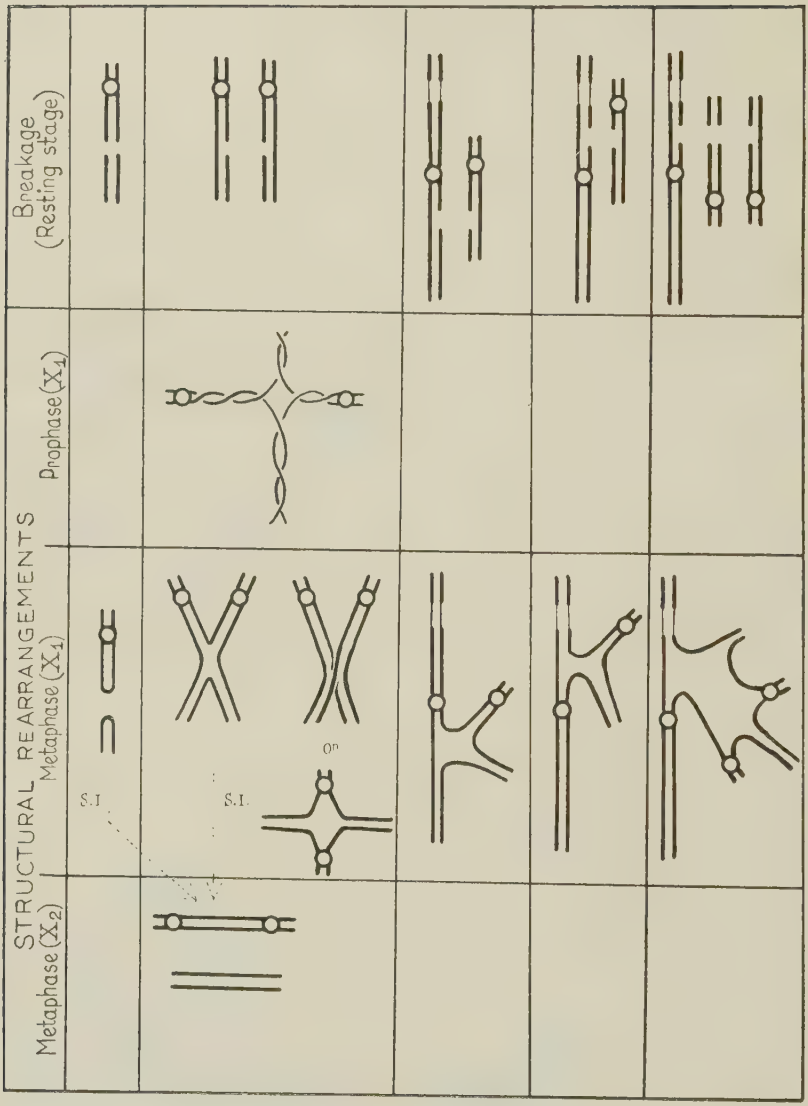
e) *Dicentric chromosomes*

A prolonged pre-treatment with colchicine (24-48 hrs.) gives rise to tetraploid cells. In some of these can be seen dicentric chromosomes and acentric fragments (see Pl. IX). It is clear that such a dicentric chromosome can only be originated from a structural change, either a sister reunion or an asymmetrical interchange, already present in its precedent diploid cell (see text-fig. VI).

Text-fig. V — 1, Asymmetrical interchange between S non-homologous chromosomes; sister reunion in one S chromosome (see Pl. VI, fig. 1). 2, Asymmetrical interchange between two S chromosomes (ai); symmetrical interchange between two S chomosomes with sister reunion (si + sr); two broken S chromosomes with sister reunion (sr) (see Pl. VI, fig. 2). 3, Asymmetrical interchange between two S non-homologous chromosomes; one acentric fragment co (see Pl. VI, fig. 3). 4, Symmetrical interchange between two S chromosomes (si); asymmetrical interchange between two S chromosomes (ai) (the correspondent acentric fragment laid near by) (see Pl. VI, fig. 4). × 2.200.



Text-fig. V



Text-fig. VI — Diagram explaining the origin of various configurations observed at prophase and metaphase:

X_1 — first mitosis after treatment.
X_2 — second mitosis after treatment (tetraploid cells arising by colchicine action).
S. I. — spindle inhibition by colchicine.

4. DISCUSSION

From the results obtained it is quite clear that bacterial products, perhaps mainly from protein decomposition (a presence of a toxin is also admissible) have a mutagenic action on the somatic chromosomes of *Vicia faba*. However, it is very difficult in this work to attempt any explanation of the cause--effect relationships, in virtue of the complexity of the medium in which the bacteria grow. In the case of experiments with *Bacillus Proteus* a tentative hypothesis is that the cause lies in the presence of putrescin.

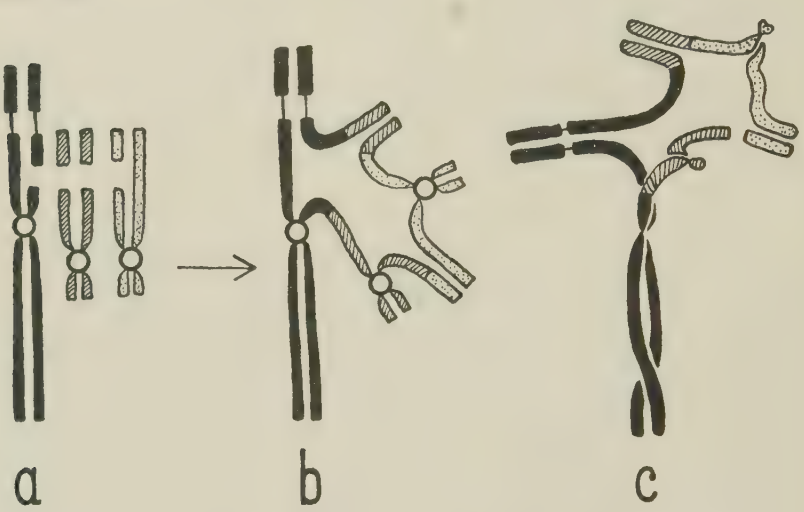
The time of breakage

From observations in structural changes such as symmetrical and asymmetrical interchanges we may conclude that these chromosomes changes were induced in resting cells. According to Revell (1953), in *Vicia faba* roots grown at 21° C, the cells which are dividing at the fastest rate complete one division cycle in about 20 hours: first part of resting stage lasts about 10 hours; second part of resting stage lasts about 8 hours; mitosis itself lasting about 2 hours. In some of our experiments the breakage was visible at metaphase 10 hours after the treatment. This means that the breakage had to occur at the second part of resting stage. But in regard to the moment of breakage, before or after the split of chromosomes, we assume that there is after, or at the time, of splitting. We based our opinion on the types of structural changes observed, all of which, with exception of SR, can be explained in terms of chromatid breaks (see text-fig. VI). The case of sister-reunion (SR) and of a S chromosome involved in two simultaneous translocations (see tex-fig. VII) can be interpreted as isochromatid breaks, that is, both chromatids are broken at the same level. This, of course, rests on hypothetical grounds.

Location of breaks

It is known that various reagents induce localised chromosome breakage. In *Vicia faba* this phenomenon has been shown by some authors. Ford (1949) observed that the nitrogen mustard breaks are almost exclusively median in position; Kihlman

and Levan (1951) have shown that breaks induced by 8-ethoxycaffeine are, in the great majority of cases, localized to the attachment thread of the satellite; Darlington and Mcleish (1951), Mcleish (1953) found that maleic hydrazide breaks the chromosomes at specific regions recognisable as heterochromatin.



Text-fig. VII — Diagram showing how a ring-like configuration can be originated by a M-S-S chromosome interchange.

a — breakage.
b — interchange.
c — the configuration as observed at metaphase (see Pl. VIII, fig. 1 and 1').

Our observations seem to show that the treatment given does not induce localised breakage, instead, like X-rays, gives rise to randomly distributed breaks.

« Spontaneous » breakage

In connection with our experiments it is important to note the phenomenon of « spontaneous » chromosome breakage in *Vicia faba* as was shown by Levan and Lotfy (1950). These authors found that after soaking the seeds of *Vicia faba* in water 24 hours prior to germination, fragments and bridges were thereafter noted, at anaphase, in the primary root tips. And they concluded about the nature of the structural changes:

« while common radiation effects and chemical radiomimetic effects include all kinds of breakages, both chromosome and chromatid breaks, the present changes are all of one kind, viz. chromosome changes. They are always symmetrical, involving both chromatids of the affected chromosome ». It is quite clear that our observed structural changes differ strikingly from those: they are mainly chromatid interchanges.

To face the objection of a possible « spontaneous » breakage in our work, three other facts must be mentioned: first, we have soaked the seeds only 12 hours prior to germination in order to diminish the partially anaerobic conditions, considered by LEVAN and LOFFY the possible cause of such fragmentation; second, the controles do not show structural changes; third, if there were X_1 « spontaneous » broken cells, the X_2 cells derived from them, would show, of course, certains chromosome types (for example dicentrics). Nevertheless we never observed that.

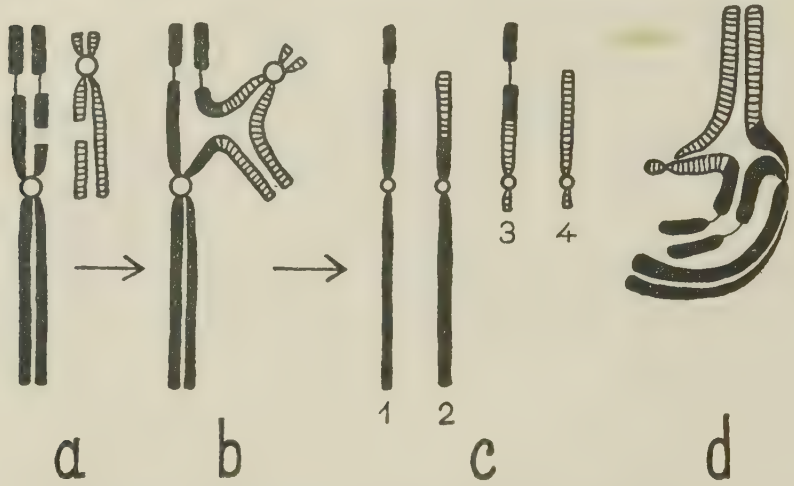
Toxic effects

It was found that the treatment with bacterial products during more than 48 hours killed the root tips. However a treatmente of 12 hours did not seem to have toxic effects because the recovery was normal. Only rare cells were seen in some root tips, in which the chromosomes were almost completely shattered (see Pl. VIII, fig. 2). An indirect proof of the non toxicity of the treatment was the observation of many X_2 cells (X_2 second mitosis after treatment) with chromosome configurations, viz., dicentric chromosomes, that are the result of structural changes occurred in X_1 cells (Pl. IX).

Evolucionary significance

Some of the structural changes observed are of those types that had been postulated and demonstrated by cytogenetics to be of evolucionary significance. The observed types are symmetrical interchange (reciprocal translocation) between non-homologous chromosomes, and small delections. Both types can be seen very clearly in many cells. Examples of reciprocal translocations are: Pl. III, fig. 1 which is a translocation between an, probably, S_1 chromosome and other S chromosome; fortu-

naly the other S1 homologous chromosome is clearly seen at right. Others examples, deduced from lenght of the translocated arms, are Pl. III, fig. 2 (si); Pl. II, fig. 3; Pl. V, fig. 1; Pl. VIII, fig. 1. A special case of translocation is that observed in Pl. VII, fig. 1, 1': there is a S-M translocation that gives rise to a two new chromosomic types: one with centro-



Text-fig. VIII — Diagram showing how new chromosome types can arise by symmetrical interchange between M-S chromosomes:

a — breakage.
b — interchange.
c — 2 and 3: new chromosomes.
d — the configuration as observed at metaphase (see Pl. VII, fig. 1).

mere submedian without secondary constriction, the other with centromere subterminal and a secondary constriction (see also text-fig. VIII). Examples of small delections (minutes): in Pl. IV, fig. 2 (arrow) a terminal delection chromatids, respectively in a S and in M chromosome; Pl. III, fig. 2 is a intercalary delection in a symmetrical interchange between two homologous chromosomes. This cell is remarkable because the structural changes observed can overcome the anaphase test; Pl. V, fig. 1 is another example of a intercalary delection in a symmetrical interchange between two non-homologous S chromosomes.

An objection can be made, however, to our assumption that such chromosome changes have evolucionary significance. The objection is that our cytological observations were limited exclusively to root tips, i.e., to a meristem from which will not originate sporogenous tissue, and therefore, those structural changes never can be transmited to the descendance. But two hypothesis (experiments are planned for testing its value) can face this objection. Firstly, when the seedling is under the soil, the stem meristem can be directly affected by the mutagenic substances. Secondly, the mutagenic substances can be translocated from the root to the apical stem meristem. This hypothesis involves the possibility that the mutagenic substances can affect the apical stem meristem at different ages of the plant, and even affect the sporogenous tissue proper. A further objection is that in our observations we used only one plant species: *Vicia faba*. This fact should warn us against generalizations.

There is one more question that must be considered in connection with our conception that the soil is the source of mutagenic substances. It is well known that in cytological literature many examples are reported under the titles « spontaneous chromosome alterations », « spontaneous chromosome variation », etc., and this, mainly related with the phenomenon, that different roots taken from the same plant differ in their chromosomal constitution. It becomes clear that our mutagenic conception of soil gives us a rational approach to interpret those findings. Also, the so called « spontaneous physiological disturbances » founded in root tips cells, in mitosis, and interpreted generally by authors as independent of the environmental conditions, can now be looked as caused several times by chemicals present in soil. In brief, considerations about *physiological disturbances* during mitosis, in root tips, can only be made in controlled conditions, viz., growing plants in a medium of known composition.

To conclude, we may say that the speculations on the possible significance of our data are predominantly of the nature of working hypothesis, which can be verified by experiment.

In the following pages we briefly state the present situation about the origin of spontaneous mutations, and present our mutagenic conception of soil.

5. STRUCTURAL CHANGES OF CHROMOSOMES AND EVOLUTION. THE ORIGIN OF MUTATIONS

As is well established, mutational changes fall into two large classes: those presumably caused by chemical alterations in the individual genes (known as point mutation) and those of a grosser structural kind involving physical destruction, multiplication, or spatial rearrangement of the genes (chromosomal mutations).

The four principal types of chromosomal mutations (structural changes) are translocations, inversions, deficiencies and duplications. All these structural changes — that imply chromosomic breakage — are factors in Evolution both in plants and in animals. Huxley (1942, pag. 92-93) says: «... rearrangements of segments of the chromosomes are far commoner, and have played a much larger part in evolutionary processes, such as the differentiation of species, than was previously supposed».

Briefly we give here the most evident prooves concerning plants (see Stebbins, 1950):

1) The mechanism of phylogenetic alteration of the basic chromosome number in plants are now well established in cytology. Darlington (1937) has shown how conditions favouring the loss or gain of a chromosome can be produced by means of reciprocal translocation of unequal chromosomal segments. Togby (1943) has fully confirmed Darlington's postulate in *Crepis*.

2) In many genera and families of flowering plants conspicuous differences in the appearance of the karyotype have been found in species having the same chromosome number. Asymmetrical karyotypes may result from symmetrical ones either by means of unequal translocations or inversions involving the centromere.

3) Structural hybridity for translocations has played an important role in plant evolution. It is readly recognized by the presence of rings or chains of chromosomes at meiosis. Typical examples are cited by Darlington (1937) and Dobzansky (1941).

4) Inversions of chromosome segments are likewise well known and probably occur in an even larger number of plants

species than do translocations. They can readly be detected in the heterozygous condition by the results of chiasma formation and crossing-over in the inverted segment. This leads generally to the formation at meiotic anaphase of one bridge and a fragment. A considerable list of plant species containing heterozygous individuals for inversions is given by DARLINGTON (1937) as well as by DOBZANSKY (1941).

Finally, we have to mention GOLDSCHMIDT'S revolutionary conception about the mechanism of Evolution. GOLDSCHMIDT (1940) takes the extreme view that all the supposed mutations are rearrangements in the chromosomes. He points out (pag. 396): « Species and the higher categories originate in single macroevolutionary steps as completely new genetic systems. The genetical process which is involved consists of a repatterning of the chromosomes, which results in a new genetic system. The theory of the genes and of the accumulation of micromutants by selection has to be ruled out of this picture ».

In conclusion, we can state without any doubt that structural changes in chromosomes played and still playing an important role in Evolution.

We arrive now at the problem: which is the spontaneous origin of those structural changes in Nature? The problem has been presented by all the modern evolutionists. For example DOBZANSKY (1941, pag. 106) recognizes: « Compared to the amount of information available on the X-ray induced structural changes, our information regarding their spontaneous counterparts is negligible ». STEBBINS (1950, pag. 463) says: « The difficulty of explaining these regular trends in the karyotype differentiation as a result of structural alterations alone is that, in spite of a large body of knowledge about such alterations produced artificially by X-radiation, no mechanism has been discovered by which they could lead to the progressive alteration of the karyotype which has been observed ».

MULLER'S discovery in 1927 that X-rays radiations cause mutations in *Drosophila* moved many authors to accept the atractive hypothesis that spontaneous mutations could be originated by natural radiation, i. e., cosmic rays from outside the earth, y-rays from the radioactive content of the environ-

ment, and α-and β-radiation from the radioactive matter in the organism itself. This possibility was however conclusively disproved not only in animals *(Drosophila)* by Muller himself in 1930, as well as in plants, where Giles (1940), working with *Tradescantia*, found that the natural radiation level is about a thousand times too small to account for the spontaneous chromosome breakage rate occurring at the pollen grain mitosis.

This impossibility of finding in the external physical conditions the cause of spontaneous mutability has taken, mainly recently, a good number of authors to look for the possible intracellular metabolic disturbances as its cause.

Navaschin was the first in 1933 to consider the mutation problem under the physiological point of view, based in the increase percentage of chromosome mutations with increase in age of seeds of *Crepis*. In his opinion: « spontaneous mutations are generally supposed to be induced by some unknown external agent. However, it may be expected that mutation is influenced also by certain intracellular processes which develop automatically and may be created or accelerated by artificial means (for example by X-rays) ». And he concludes: « that the main agency that caused spontaneous chromosomal mutations should be sought not outside but rather *inside* the cell. The same would probably also hold true for factor mutations ».

Darlington and Upcott (1941) recognise: « For spontaneous change, on the other hand, we are still very much in the dark. Recent work however, has shown that within the limits of natural conditions unimagined possibilities occur for structural change in the chromosomes. Such possibilities arise under three general types of condition: first, extreme natural conditions, e.g. temperature; secondly, special genotypic conditions, e.g. mutation, hybridity or segregation; thirdly, differentiation within the organism leading to abnormal conditions in *blind* or disintegrating tissues ».

Resende (1948), based in cytological observations, concludes that: « whatever the causes of the chromosomic changes, the first effect of these causes to be noted is the chromatic agglutination (= physiological changes) and the chromosomic

changes would, perhaps, be no more than the effect of an intense chromatic agglutination».

Serra (1948) expresses the same opinion: «Possibly, the chief cause of spontaneous breakage is chromatin agglutination (Resende, 1947) by the mechanism of matrix bridge formation. And he adds: «It is also possible to suppose, however, that sometimes a sufficient amount of energy is liberated by exoenergetic reactions at the immediate vicinity of the chromonema, and thermal oscilation may also be operative in causing chromonema breaks. As in the case of mutations, it seems that cosmic rays will not be of a marked importance in causing «spontaneous» breaks».

Fernandes (1951a), in his cytological studies on the phylogeny of the genus *Narcissus*, assumes that: «En ce qui concerne les facteurs du milieux auxquels doivent être imputées les altérations génotypiques responsables pour la différenciation de taxa nouveaux à l'état spontané, nous croyons que le rôle le plus important a été joué par l'action de la température et des radiations ultra-violettes. . . . En ce qui concerne les radiations cosmiques, la radioactivité naturelle, ainsi que l'action des substances chimiques absorbées ou élaborées par ces plantes dans les conditions naturelles rien n'est connu à présent, bien que nous pourrons soupçonner que ces agents, particulièrement le dernier, pourront avoir aussi joué leur role».

D'amato (1952), in a recent revision concerning the problem of origin in spontaneous mutations, states: «In conclusion, spontaneous mutation could be interpreted as a kind of response to special metabolic or physiological conditions. Cells or tissues might not be protected against an increase in the concentration of some metabolites normally present in the organism (or the organ), or they might suffer from the chemical action of «new» compounds formed in special physiological conditions as a consequence of internal and / or external influences».

Oehlkers (1953) says: «It is especially important that in both cases spontaneous breaks differ most striklingly from randomness, and that the substances showing a distribution similar to the spontaneous are inorganic salts and nucleic acid derivatives. Therefore we now have a possibility of explaining the origin of spontaneous mutations; they may be due to the

accidental presence of such substances in the plant, as is evident of the random reception of salts and the dissimilation of organic materials».

Koller, in a quite recently (1954) revision about chromosome breakage, concludes «The question arises: what is the cause of the «spontaneous» breaks? ...Intracellular metabolic disturbance due to environmental factors (e. g. changes in oxygen tension, in temperature, etc.) are most likely the immediate cause of such events in cells. ...The natural breakage of chromosomes is brought about by the response of cellular metabolism to environmental influences. From the evolutionary aspect it is an event of great importance, and in the study of the experimentally induced chromosome reaction it is of fundamental significance».

In his recent book, Haldane (1954, pag. 102-103) points out: «A beautiful edifice of speculation was reared on the mutagenic effect of radiations and particles. A highly poetical version of it may be found in Schrödinger (1944). It was brought down to earth by three fundamental observations. Auerbach and Robson (1942, 1947) were allowed to publish their finding that β-β'-dichlorethly sulphide causes large numbers of mutations in *Drosophila*. Earlier claims for chemical mutagens are of doubtful validity. Thoday and Read (1948) found that the number of chromosomal breaks produced by irradiation of *Tradescantia* pollen increases with the partial pressure of oxygen, the number produced in nitrogen being about a quarter of that in air. Stone, Wyss and Haas (1947) showed that the irradiation of a medium on which bacteria are later grown will produce mutations like those caused by directly irradiating the bacteria. It became clear that mutagenesis is a biochemical rather than a biophysical process».

Demerec (1954) based in experimental study of mutation in bacteria concludes: «Our results indicate that the stability — or mutability — of the genic system of a cell is closely integrated with the life processes that go on in the cell. They suggest that changes in the internal functioning of cells — in cell metabolism — are responsible for changes in genes (gene mutations)».

We may conclude then that the modern orientation in the

study of origin in mutations (not only structural but genic) tends to consider them like a typically physiological event that can be explained on metabolic grounds.

In the present work it is observed that an external influence — bacterial products — cause an intracellular metabolic disturbance which certainly leads to the breakage of chromosomes. But the most interesting fact about our observations, is that they allow us to make an extrapolation of high significance, i. e., bacterial products are in natural conditions, in the soil, a powerful source of inducing chromosome mutations. This extrapolation is permissible in regard to the general occurrence of bacteria in the soil where they promote many biochemical activities. In our opinion this *mutagenic conception of soil* adds to the solution of the much debated problem about the origin of spontaneous mutations.

6. A MUTAGENIC CONCEPTION OF SOIL

It is surprising that up to date no one has given any real value to the possible mutagenic action by the numerous and varied organic substances that exist in the soil. This is perhaps due to the classical idea that plants absorve from soil only water and mineral salts. However, in a more correct interpretation, the soil may be looked upon not only as a medium supporting growth of higher plants but as a complex natural environment inhabited by a very greater active population: the microbial life. The microorganisms that make up the soil population include the numerous groups of Bacteria, Actinomyces, Fungi, Protozoa, Algae and small Invertebrate animals, but by far the most numerous and important are Bacteria. Bacteria are in fact largely responsible for the numerous chemical changes constantly going on in the soil, principally as agents of destruction of the complex organic molecules synthesized by plants and transformed by animals. Coincident with this destruction is the construction or formation of new compounds. For example as a result of microbial attack upon proteins there are formed carbon dioxide, ammonia, and various incompletely decomposed organic substances. From the decomposition of carbohydrates, carbon dioxide, organic acids, and alcohols are

formed. Many of these organic substances, like carbohydrates, alcohols, organic acids, peptones, amino-acids, purine bases are known (Waksman and Starkey, 1931 pag. 194-195) to be absorbed by plant roots. Further, Bacteria and Fungi produce in the soil (Pramer and Starkey, 1950; Grossbard, 1950, Gottlieb and Siminoff, 1950) the well known organic substances called antibiotics which have powerful physiological activities.

Now, an interesting fact can be noted: some of the substances that we know exist naturally in the soil have been demonstrated « in vitro » to be highly mutagenic. Putrescin, an amine, resulting from decarboxylation of ornithine amino acid by the action of certain bacteria *(Bacillus Proteus; Escherichia coli; Clostridium septicum)*, was verified to induce chromosome breakage (Marquardt, 1949 a, 1950). This author used a solution of putrescin hydrochlorid injected through the stems of excised inflorescences of *Oenothera* and he concluded that 40 % pollen mother cells appeared with chromosome aberrations.

Another group of substances, which we know exist naturally in soil, the purine derivatives, has been demonstrated, « in vitro », by Kihlman (1950 a, b, 1952) in root tips of *Allium Cepa* and *Pisum sativum* to induce structural changes in chromosomes. But these two authors, when approaching the problem of the origin of spontaneous mutations, simply considered these substances (putrescin and purine derivatives) as having probably an internal origin, that is, degradation products of metabolism within the affected being.

Another large group of organic substances existing in soil, with a mutagenic action, tested « in vitro », that has been recently investigated are the antibiotics. Wilson (1950) and Wilson and Bowen (1951) tested the action of various antibiotics (Penicillin, Streptomycin, Aureomycin, etc.) in *Allium* root tips. These authors concluded that there were not any chromosome breakage but only cytological effects of the type generally referred to as « C-mitosis ». But Levan and Tjio (1951) observed, also in *Allium* root tips, that Penicillin causes, although with very low frequency, chromosome breakage. More recently, Tanaka and Satô (1952) tested the effects of Strepto-

mycin on the mitotic cells of *Tradescantia paludosa* and concluded: « Taking into consideration all the data now available, concerning the effect of Streptomycin upon either microorganisms or higher plants it seems most likely that the action of Streptomycin upon mitotic cells is to be mutagenic, and is able to induce both minor genic recombinations and major alterations such as translocation or polyploidy ».

In conclusion we may say that we interpret the soil as the source of mutagenic substances, which, under determinated conditions of concentration and physiological status of the affected being — and possibly the most affected status can be the seedling — will induce chromosome mutations or even genic. This means that the principal agent of inducing spontaneous mutations in plants, lays in *external* factors and not within *internal* factors.

7. RELATED PROBLEMS: CROSSING-OVER AND CANCER

Crossing-over

Although the mechanics of meiosis is well known its physiology is poorly understood. The most important phenomenon occuring during meiosis is crossing-over, that is, a natural periodic chromosome breakage and reunion, which occurs at the end of pachytene. The causes of that breakage are however unknown. This is well expressed in KOLLER's words (1954): « Crossing-over is an event of the greatest importance in evolution, yet so far no satisfactory analysis has been made of its biophysical and chemical aspects ».

The recent works in inducing chromosome breakage with chemicals show, however, to open a new line of approaching the problem of crossing-over. As REVELL points out (1953): « there is no reason to suppose that a chemical substance can act on the chromosomes in the sort of randomly corrosive fashion which has sometimes been assumed. There seem to be two ways, however, in which chemical mutagens might produce a kind of breakage. Firstly, they might act as inhibitors of chromosome synthesis: on such a theory a break is really a gap, perhaps a small delection, where the normal structure of the chromosome has been interrupted... Secondly, they might

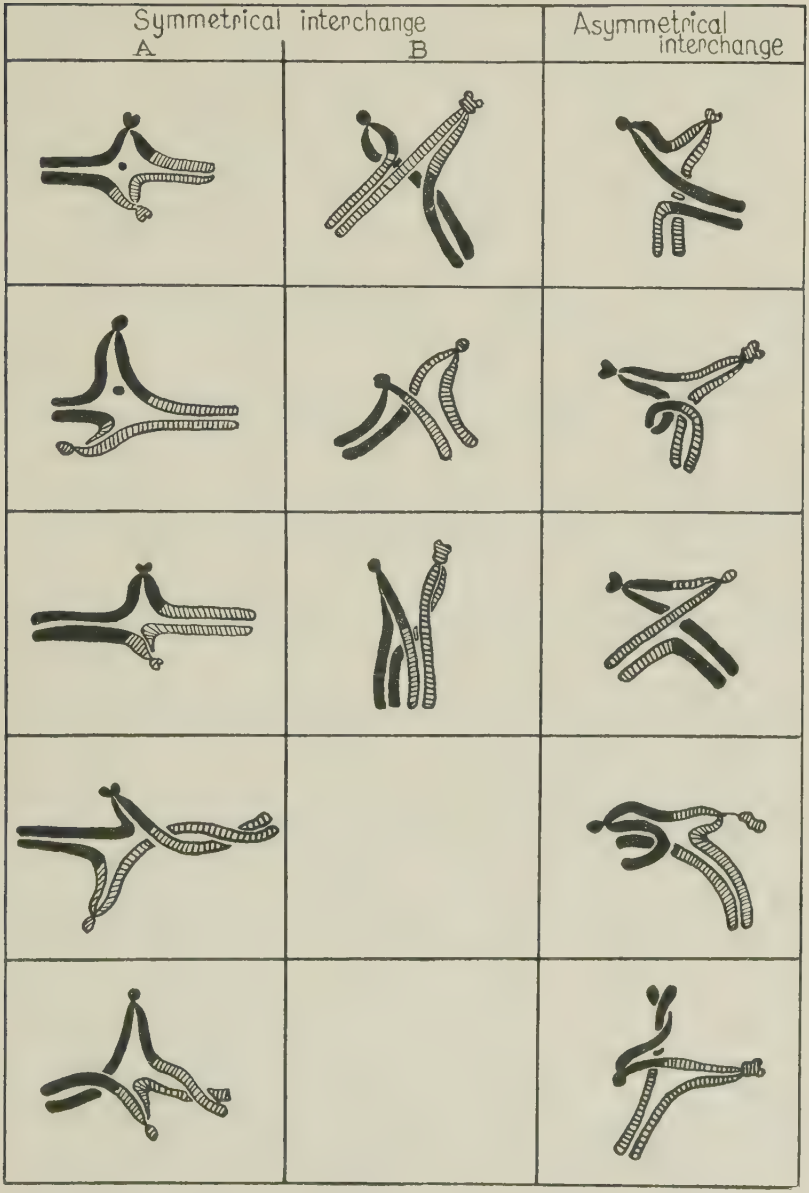
act so as to interfere with the proper function of certain postulated labile sites along the chromosome lenght which normally break down only at meiotic crossing-over: this really amounts to the suggestion that mutagen acts by reason of its ability to induce a kind of illegitimate chiasma formation at some stage during the mitotic cycle».

We are tempted to interpret our cytological observations mainly in accordance with REVELL's second point of view. We based our opinion in the following. Firstly, a proportion of symmetrical interchanges seems to be between homologous chromosomes at apparently homologous points (see Pl. II, fig. 2; Pl. III, fig. 2; Pl. VIII, fig. 3, and note the resemblance with meiotic bivalents; see also text-fig. IX). Secondly, in all the interchanges observed, both symmetrical and asymmetrical, only two of the four chromatids are broken. In other words, we have here the same puzzling phenomenon that occurs at crossing-over. Further, if we assume that some sort of chromosome pairing is a prerequisite for chemical induction of interchanges, we must conclude that in induced somatic crossing-over, this pairing is not so specific as in meiosis, and can occur both in homologous and non-homologous chromosomes (see, for example Pl. III, fig. 1 and Pl. VII, fig. 1) as cases of non-homologous chromatid interchanges.

To conclude, we interpret meiosis as an event in the life of chromosomes, that occurs in special physiological conditions. These conditions are present, for example, in a sporogenous tissue, or even in a single specialized cell as a zygote. But these same conditions can be partially imitated experimentally, in somatic tissues, by means of chemicals, leading, of course, in a desynchronized and abnormal fashion, to some stages of a such meiotic process. And we arrive then at this situation: the same basic phenomenon — chromosome breakage — is a powerful factor in Evolution, both in its normal and synchronized form, i. e., crossing-over, and in its abnormal and desynchronized form, i.e., interchanges.

Cancer

The study of chemical mutagenesis is considered to be related very closely to two lines in cancer research: the nature



Text-fig. IX — Diagram illustrating some interchanges (symmetrical and asymmetrical) as observed at metaphase. In row *A* note the resemblance with meiotic bivalents at diakinesis; in row *B* note the chiasma-like configuration.

of chemical carcinogenesis, and the research for chemical compounds which are specific growth inhibitors. In relation to the first problem, it is important to note the works of STRONG (1949) and DEMEREC (1949) who showed that carcinogenic compounds (mainly carcinogenic hydrocarbons) can induce mutations respectively in mice and in *Drosophila*. These authors came to the conclusion that « all carcinogens are mutagens and all mutagens are carcinogens ». The power of carcinogens to induce mutations is not restricted to animals, but can be generalized to plants, as revealed by the finding of TATUM (cited by STRONG) that have obtained mutations in the fungus *Neurospora*, with a derivative of methylcholantrene. This discovery, that carcinogenic compounds can induce mutations, greatly reinforces the idea that cancer may arise by a process of somatic mutation. But in connection with our problem, i. e., chromosome breakage, it is interesting to note that DEMEREC, in his experiments has also found that some carcinogens can induce chromosome breaks in *Drosophila*. This correlation between chromosome breakage and carcinogens is, however, better revealed in KOLLER'S experiments (1953) who has found that aromatic nitrogen mustards have the power of inducing malignant tumour in rat. This tumour was accompanied with structural changes in the chromosomes (mainly dicentrics). A tentative hypothesis is then to correlate these chromosome breaks with the « somatic mutation » that leads to malignant growth.

In relation to the second problem, destruction and elimination of dividing cells responsible for the malignant growth, it is important to note that some compounds that are known to be mutagenic, inducing structural changes in the chromosomes, have been utilised recently in chemotherapy of cancer in man. These are the nitrogen mustard and urethane (see GREENSTEIN, 1947, pag. 171-172 and CADE, 1951, pag. 10-12). In rats, nitrogen mustard was found to brought about the inhibition of tumours (carcinoma) by the mechanism of chromosome injuries in the dividing cells (KOLLER, 1953).

Have our observations anything to do with the cancer problem? Although very remote, we assume that there is a point of contact with an interesting fact: it is known (GREENSTEIN, 1947, pag. 164-167) that the administration of bacterial products

(the so-called COLEY's toxins) can, in some cases, cause partial and temporary regressions of human malignant tumours. The mechanism of primary effect of bacterial materials is still unknow, however, as GREENSTEIN say « It is possible that the newly formed capillaries of the growing tumour are more sensitive to the action of extrinsic agents than the blood vessels elsewhere in the host ». In the absence of cytological data we can only, on hypothetical grounds, assume that in this phenomenon the causes of cell destruction lie at the chromosome injurie level. However, from these facts, it follows that bacterial products as a tool for cancer therapy, and, perhaps for its induction, are a very interesting line of research, as GREENSTEIN himself recognizes: « It may even be that the purification of the bacterial products may either go too far or not far enough. The possibilities of further experimentation are endless ».

Looking over all these facts, we can outline a suggestive scheme: A carcinogen is a chemical that induces a « somatic mutation », perhaps closed associated with structural changes in the chromosomes. This mutation leads to a malignant growth. But this same chemical can now be utilized to the destruction of the uncontroled dividing cells, by means of inducing unviable chromosome structural changes. This contradictory aspect is no more than one fundamental property of the carriers of genes, i. e., the chromosomes: they can suffer the attack from environmental conditions (internal or external) and its response can be a controled or balanced one, viz. crossing-over, viable structural changes, or a descontroled and unbalanced one, viz., cancer, unviable structural changes leading to death of cells.

8. SUMMARY

1. It is observed that bacterial products, perhaps from protein decomposition, are mutagenic, inducing structural changes in the chromosomes of the root tip of *Vicia faba*.

2. The induced structural changes are symmetrical and asymmetrical interchanges, both between homologous and non-homologous chromosomes, sister-reunion, and small delections.

3. It is stressed that all the experiments utilizing as supposed mutagens, organic matter susceptible of bacterial decomposition, viz., extracts from seeds or other organs, must be conducted in aseptic conditions.

4. Because bacteria in soil have a powerful chemical activity, a *mutagenic conception of soil* is presented, that is, the soil is the source of mutagenic substances. In the author's opinion, this will add to the solution of the much debatable problem of origin of spontaneous mutations in Nature.

5. Some considerations are made about two related problems: crossing-over and cancer.

ACKNOWLEDGMENTS

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PLATES

Explanation of Plate I

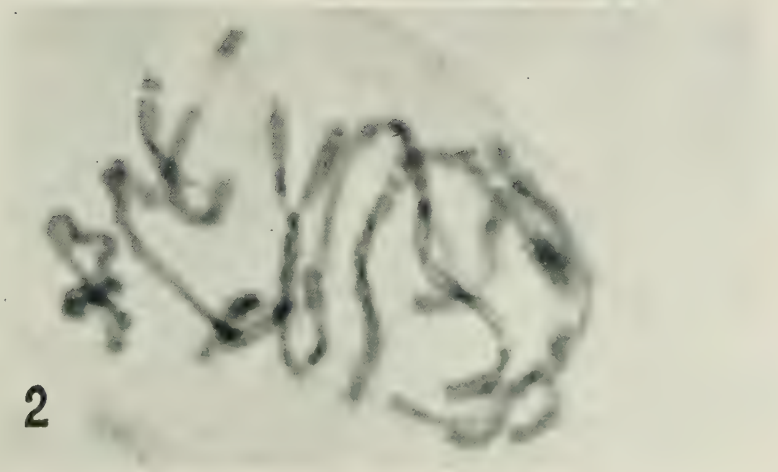
Fig. 1 — The 12 chromosomes of *Vicia faba* (for nomenclature see pag. 150-151, see also text-fig. 1).

× 2.700

Fig. 2 — Nucleus at prophase. Note the pronounced relational coiling of the chromatids.
Mixed bacteria: meat-extract broth / 12 hrs. / Recovery / 12 hrs.

× 2.200


S4
S3
S2
S4
S5
M
M
S5
S3
S1
S2
S1
1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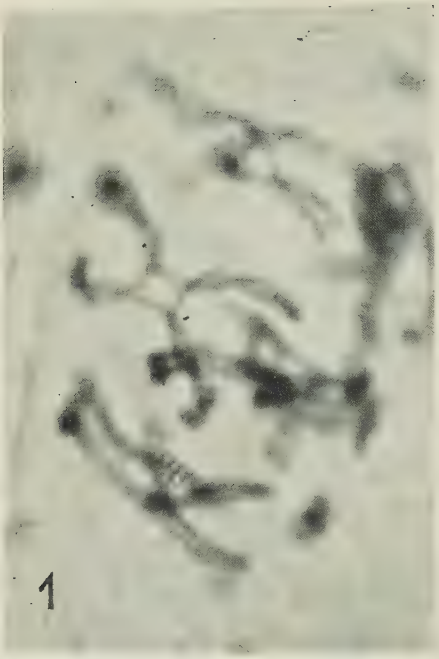

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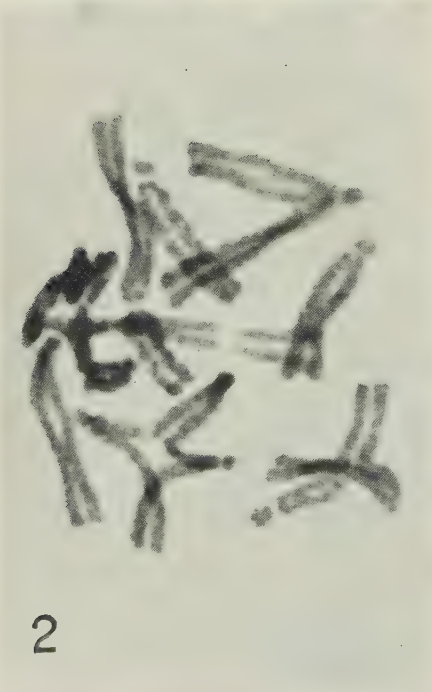
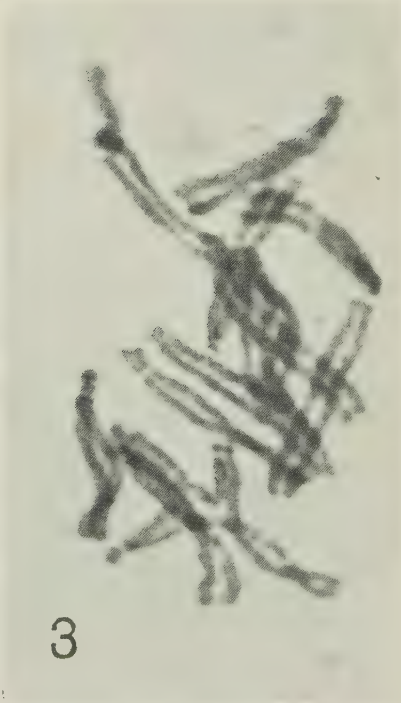




Explanation of Plate II

Fig. 1. 1'. — Symmetrical interchange between two S chromosomes detected at prophase.
Mixed bacteria: unknown organic matter / 10 hrs.

× 2.200

Fig. 2 — Symmetrical interchange between two S homologous chromosomes; S-S symmetrical interchange + SR. (see text-fig. II, 3).
Mixed bacteria: meat-extract broth / 12 hrs. / Recovery / 12 hrs.

× 2.200

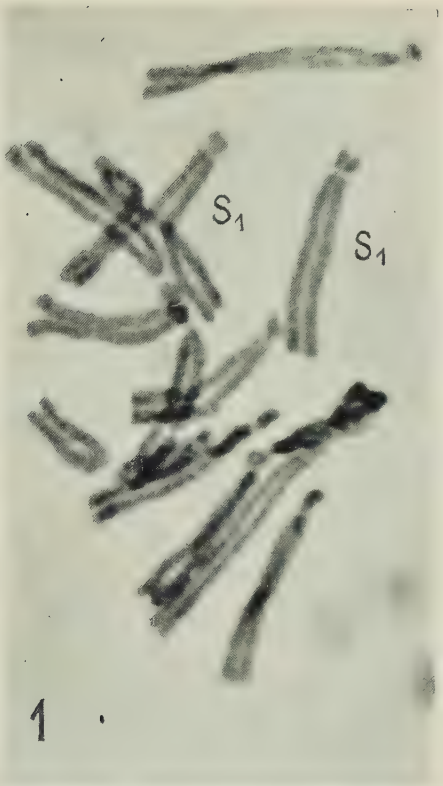
Fig. 3 — Symmetrical interchange between two S non-homologous chromosomes (see text-fig. II, 4).
Mixed bacteria: meat-extract broth / 12 hrs. / Recovery / 12 hrs.

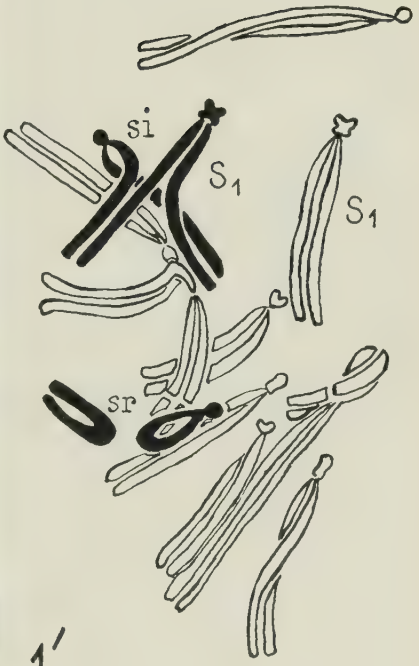
× 2.200

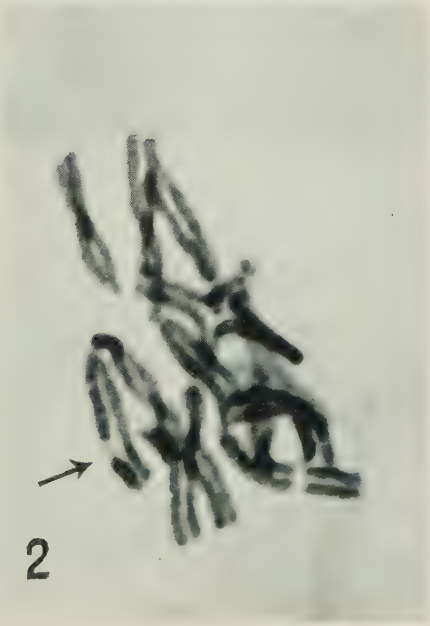
Explanation of Plate III

Fig. 1. 1'— Symmetrical interchange between two non-homologous chromosomes (one is probably the S_1 chromosome, and its homologous is clearly seen at right). Note the chiasma-like configuration. Sister reunion (sr) in one S chromosome.
Mixed bacteria: meat-extract broth / 12 hrs. / Recovery / 12 hrs.
$\times 2.200$

Fig. 2. 2'— Symmetrical interchange between two homologous S chromosomes, with an intercalar minute (si + m). Symmetrical interchange (si) between S_1-S chromosomes. The arrow shows absence of nucleolar thread in one chromatid.
Mixed bacteria: unknown organic matter / 10 hrs.
$\times 2.200$


S1
S1
1


si
S1
S1
sr
1′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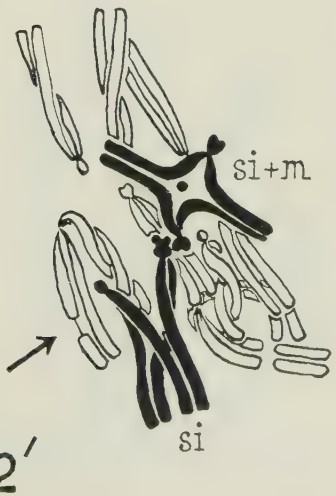
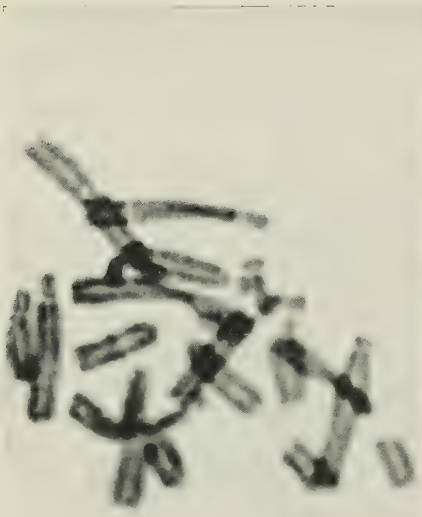

si+m
si
2′



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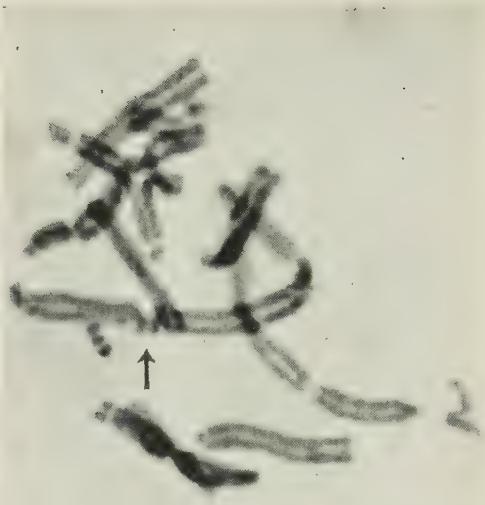

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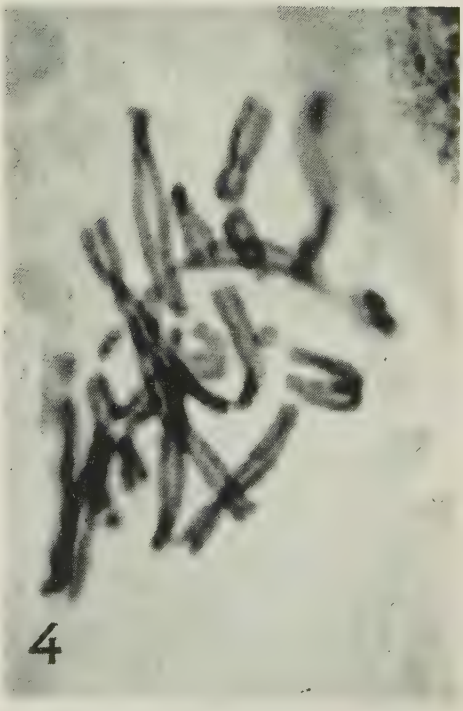


4

Explanation of Plate IV

Fig. 1 — S-S chromosomes symmetrical interchange. SR in five S chromosomes (see text-fig. III, 1).
Mixed bacteria: unknown organic matter / 10 hrs.

× 2.200

Fig. 2 — S_1-S chromosomes asymmetrical interchange. SR in two S chromosomes. Note simulated pairing (arrow) of non-homologous chromatids. At left the correspondent minutes to the terminal delections (see tex-fig. III, 2).
Mixed bacteria: unknown organic matter / 10 hrs.

× 2.200

Fig. 3 — Two asymmetrical interchanges between S chromosomes. M-S chromosomes interchange, close to the centromere of the M chromosomes (see text-fig. III, 3).
Mixed bacteria: meat-extract broth / 12 hrs. / Recovery / 12 hrs.

× 2.200

Fig. 4 — SR in one S chromosome. Asymmetrical interchange between S_1-S chromosomes (see text-fig. III, 4).
Mixed bacteria: unknown organic matter / 10 hrs.

× 2.200

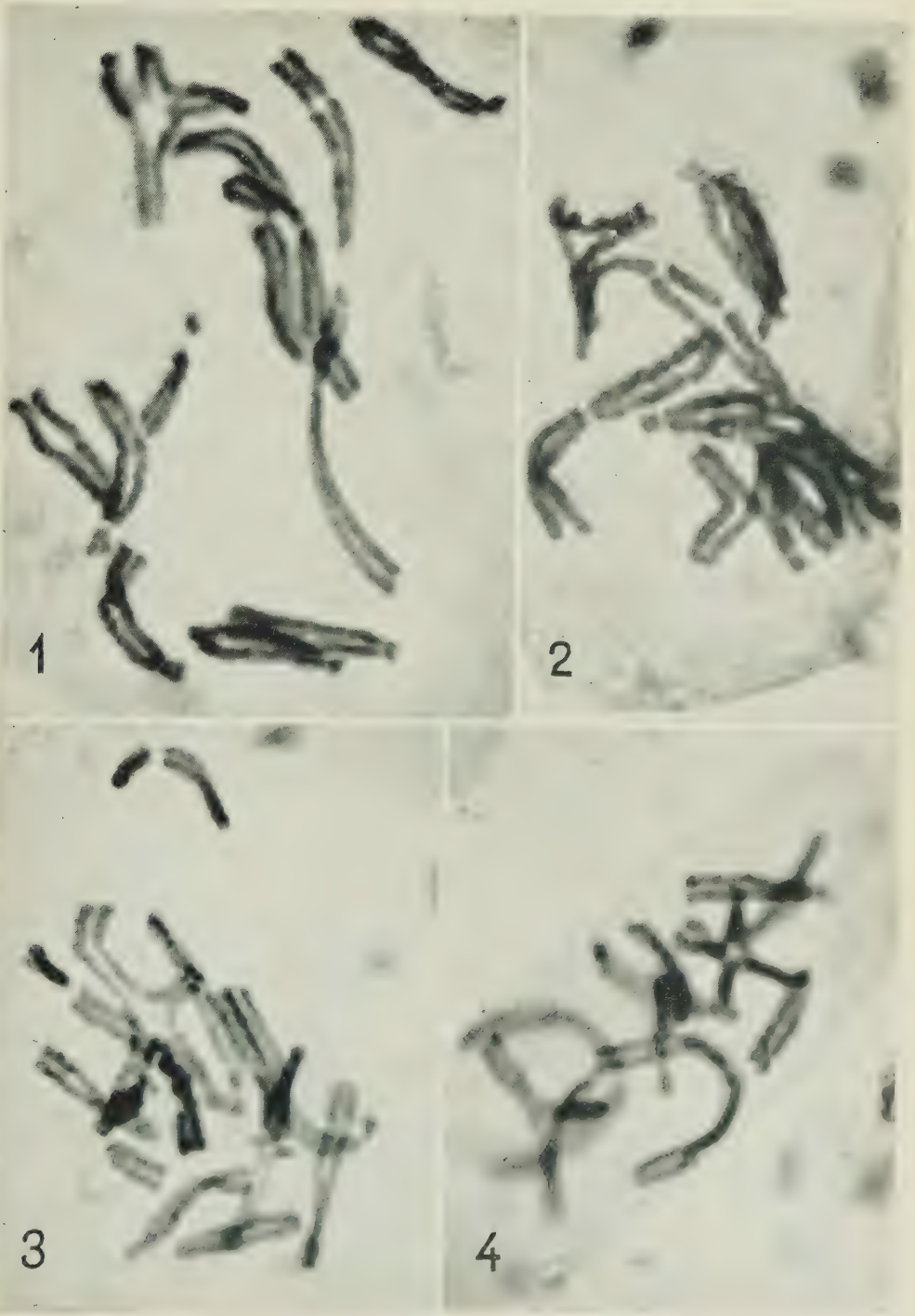
Explanation of Plate V

Fig. 1 — Symmetrical interchange between two S non-homologous chromosomes, with a minute. SR and intercalar delection in a S chromosome (see text-fig. IV, 1).
Mixed bacteria: meat-extract broth / 12 hrs. / Recovery / 12 hrs.
$\times$ 2.200

Fig. 2 — Asymmetrical interchange between two S chromosomes (see text-fig. IV, 2).
Mixed bacteria: meat-extract broth / 12 hrs. / Recovery / 12 hrs.
$\times$ 2.200

Fig. 3 — Asymmetrical interchange between two S non-homologous chromosomes. SR in one S chromosome. Breakage at the centromere of one M chromosome (see text-fig. IV, 3).
Mixed bacteria: meat-extract broth / 12 hrs. / Recovery / 12 hrs.
$\times$ 2.200

Fig. 4 — Two asymmetrical interchanges between S chromosomes (see text-fig. IV, 4).
Mixed bacteria: unknown organic matter / 10 hrs.
$\times$ 2.200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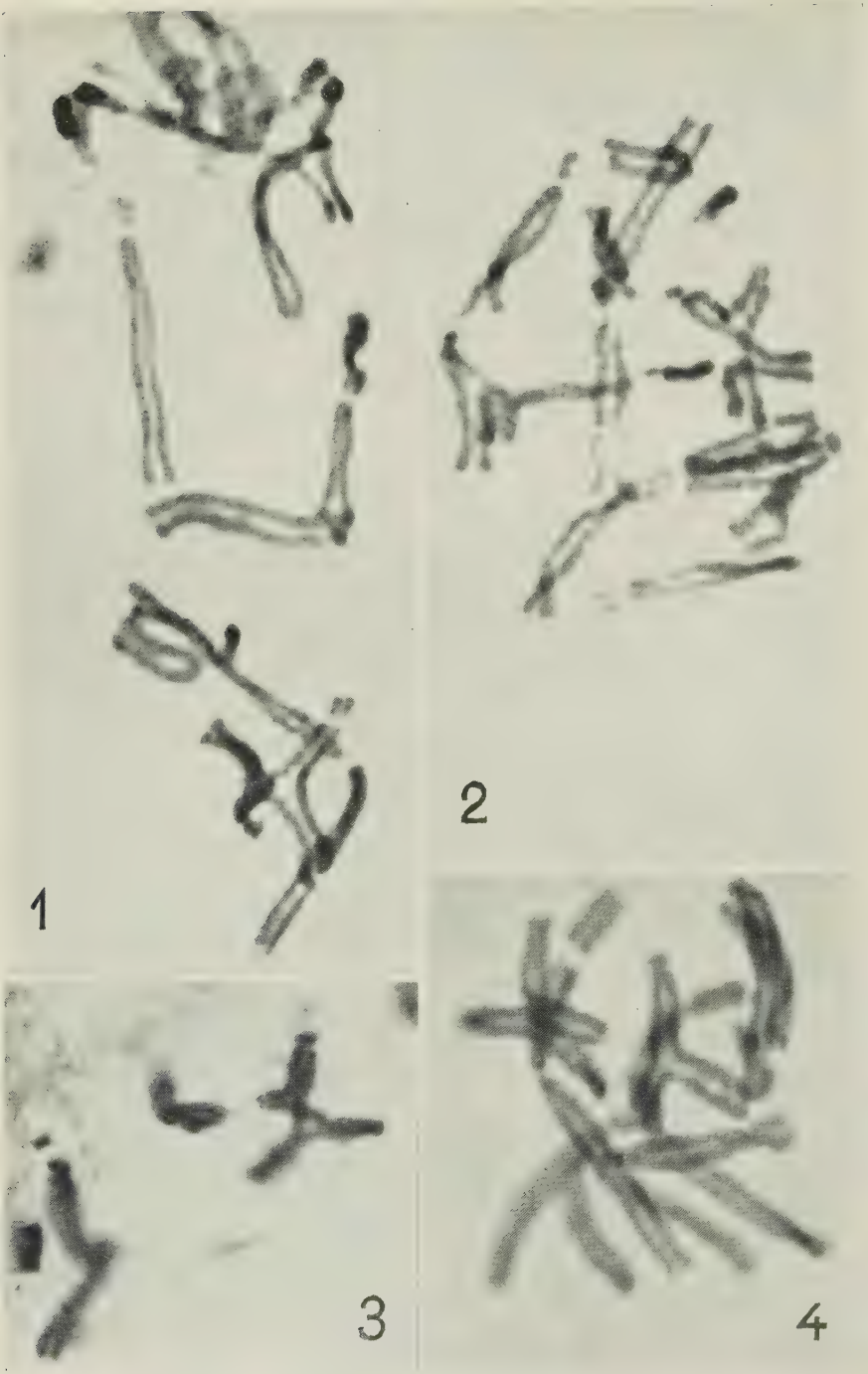
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Explanation of Plate VI

Fig. 1 — Asymmetrical interchange between two non-homologous chromosomes. SR in one S chromosome (see text-fig. V, 1). Mixed bacteria: meat-extract broth / 12 hrs. / Recovery / 12 hrs.

$\times 2.200$

Fig. 2 — Asymmetrical interchange between two S homologous chromosomes. Symmetrical interchange between two S chromosomes, with SR. Two broken S chromosomes with SR (see text-fig. V, 2).
Mixed bacteria: meat-extract broth / 12 hrs / Recovery / 12 hrs.

$\times 2.200$

Fig. 3 — Asymmetrical interchange between two S non-homologous chromosomes. One acentric fragment (see text-fig. V, 3). Mixed bacteria: unknown organic matter / 10 hrs.

$\times 2.200$

Fig. 4 — Symmetrical interchange between two S chromosomes (the acentric fragment laid near by) (see text-fig. V, 4). Mixed bacteria: unknown organic matter / 10 hrs.

$\times 2.200$

Explanation of Plate VII

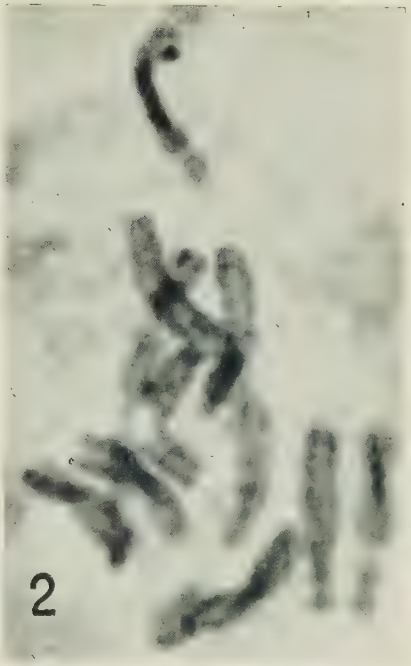
Fig. 1. 1'— Symmetrical interchange between non-homologous S and M chromosomes (unfortunately the configuration was squashed out of a non identified cell). This interchange gives rise to two new types of chromosomes (see text--fig. VIII).
Bacillus Proteus: meat-extract broth / 6 hrs. / Recovery / 24 hrs.
× 2.500

Fig. 2. 2'— Asymmetrical interchange between non-homologous S and M chromosomes, giving rise to an acentric fragment and a dicentric chromatid.
Bacillus Proteus: meat-extract broth / 6 hrs. / Recovery / 24 hrs.
× 2.500

Fig. 3 — Breakage at the nucleolar arm of the M chromosome. S_1--M (?) chromosomes interchange (see text-fig. II, 1).
Mixed bacteria: unknown organic matter / 10 hrs.
× 2.200

1

1′



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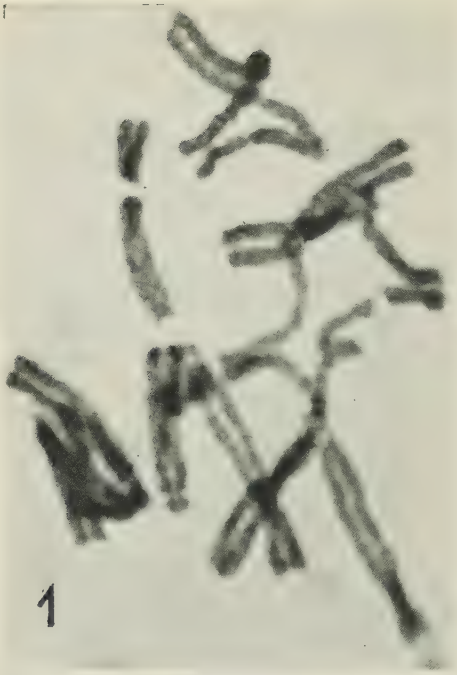
3

2′



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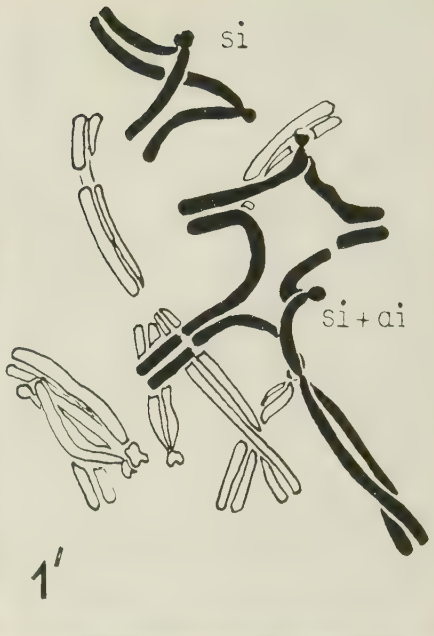
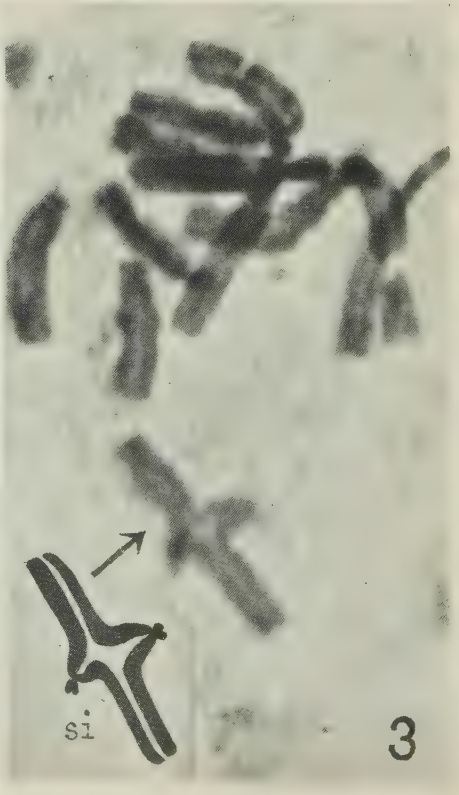


1'

2



3

Explanation of Plate VIII

Fig. 1. 1' — An M-S-S chromosomes interchange (*si* + ai) giving rise to a ring-like configuration. A gap is seen at the point of reunion of a translocated chromatid segment. A symmetrical interchange between two non-homologous S chromosomes (note the chiasma-like configuration).
Mixed bacteria: meat-extract broth / 12 hrs. / Recovery / 12 hrs.
× 2.500

Fig. 2 — An example of extreme chromosome fragmentation.
Mixed bacteria: meat-extract broth / 12 hrs. / Recovery / 12 hrs.
× 2.500

Fig. 3 — Symmetrical interchange between two S homologous chromosomes (si) (note the diakinesis-like configuration) (see text-fig. II, 2).
Bacillus Proteus: meat-extract broth / 6 hrs. / Recovery / 24 hrs.
× 2.500

Explanation of Plate IX

A giant tetraploid cell originated after 24 hours colchicine pre-treatment. A dicentric chromosome (C_2) is well seen. For its origin see text-fig. VI. 23 centromeres and two acentrics fragments can be seen. One S chromosome stood outside the cell.

Bacillus Proteus: meat-extract broth / 6 hrs. / Recovery / 24 hrs.

$\times 1.500$


C2

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